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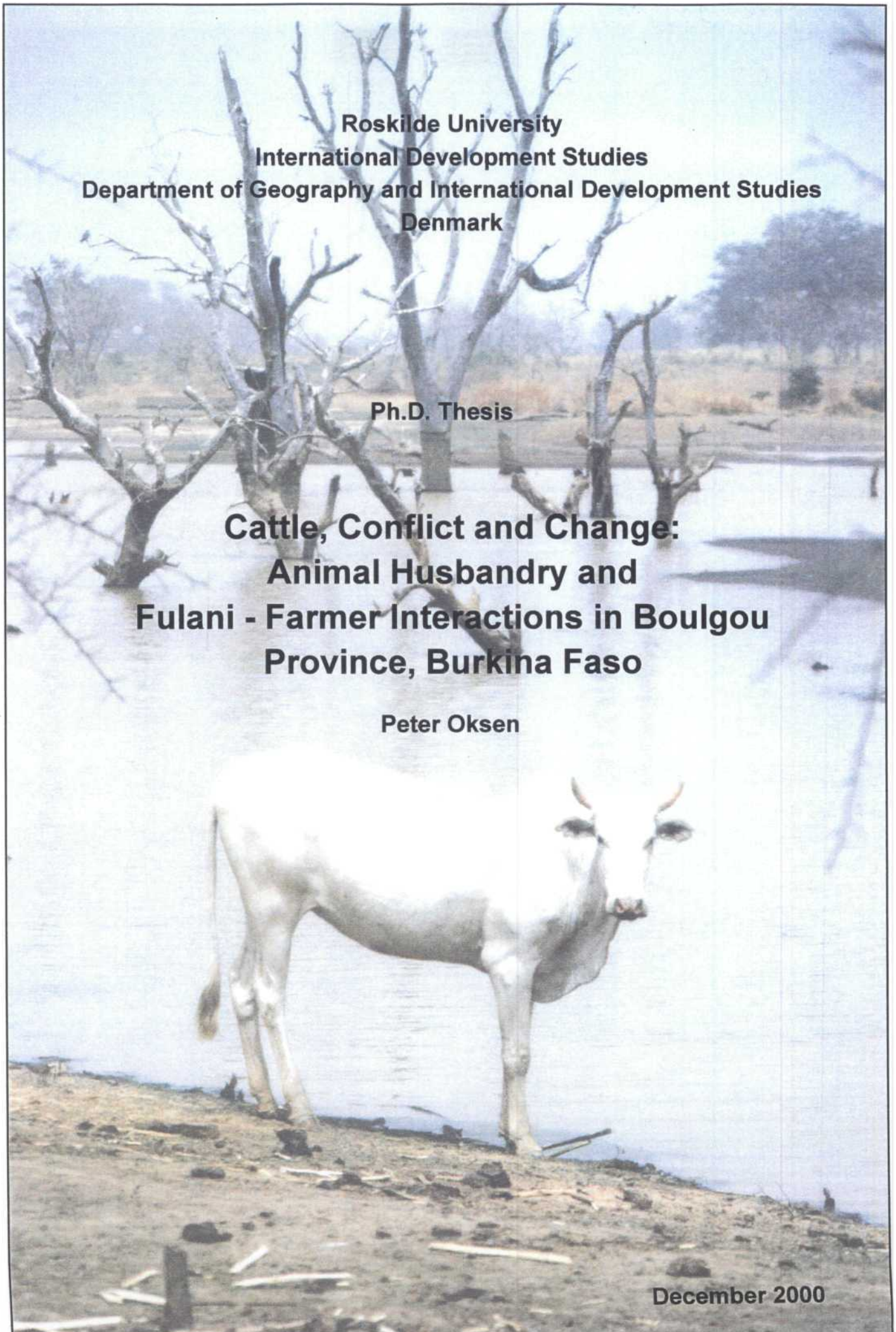
Denmark

Ph.D. Thesis

Cattle, Conflict and Change: Animal Husbandry and Fulani - Farmer Interactions in Boulgou Province, Burkina Faso

Peter Oksen



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Cover photo: Cow at the inundated shores of Lake Bagré February 1997 (photo by the author)

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Abstract

The study focuses on the animal husbandry of Fulani pastoralists and interactions with the sedentary crop farming of Bisa farmers in a Soudanian West-African savannah environment in the South-eastern Burkina Faso (Boulgou Province). Animal husbandry has, in the last couple of decades, become increasingly important in the southern regions of Burkina Faso where the major part of the crop farming in Burkina Faso is also taking place. Thus, animal husbandry and crop-cultivation share a wide variety of natural resources under conditions of increasing scarcity due to agricultural expansion and high rates of population growth. The study shows how these activities are predominantly based in distinct ethnic or socio-cultural groups, and that important complementary links between these groups support the feasibility of both activities. However, agricultural expansion is making it increasingly difficult for the pastoralists to manage the cattle herds, with the consequence that they are forced to abandon their villages and move to distant pastures often on permanent basis. This process is taking place through conflicts, especially over damaged crops due to stray animals, and the general relationship between the pastoralists and the farmers seems to have aggravated as the agricultural expansion progresses. One of the most important complementary link between the two groups is the entrustment system where the cattle of the fanners are being herded by the pastoralists most often in long-term arrangements. Entrustment is important for the feasibility of the farmers' animal husbandry, as it reduces the opportunity costs for the farmer in relation to labour that would otherwise have been allocated to maintenance of the animals. Thus, the farmers' feasibility for keeping cattle, and hereby for adopting animal traction, is closely related to the pastoralists living in the vicinity. Animal traction is a central factor in the intensification of farming systems. Following the Boserupian theories of agricultural intensification, the systems should gradually adopt animal traction, as need for labour-saving technologies would establish itself with shorter fallow periods and the consequent need for more elaborate tilling and nutrient management. In the Boserupian model agricultural expansion is seen as an integral part of and forerunner for intensification. The study shows how agricultural expansion and intensification are distinct processes that may not be seen as part of the same development. This is especially the case when the exploitation systems are founded on the activities and values of distinct socio-economic groups, as then expansion of one system constrains the other, which may lead to its abandonment. In the study, this process is illustrated by the consequences of the agricultural expansion for the animal husbandry of the Fulani pastoralists. As the feasibility of animal husbandry for both pastoralists and farmers hereby is undermined as the preconditions for entrustment are removed, it is shown that agricultural expansion may work against the further agricultural intensification through the mixed farming model incorporating animal traction. This process is in the study termed the expansion paradox. The expansion paradox is one among several complex processes influencing the development in the study area. It is in the study not possible to determine which factors are the most important. The major ambition of the study is to show the effects of the agricultural expansion on pastoralism. As the animal husbandry of the pastoralists is so closely related to the farming systems of the peasants, it has also been shown that this is not just a matter of the marginalisation of a minority group and their animal husbandry, but that it also has more far-reaching implications for further agricultural development. The comparative advantages of Burkina Faso, and specifically Boulgou Province, in relation to animal husbandry represent an important present and future economic potential. The Fulani and the entrustment system is a key to the feasibility of animal husbandry, which is why a marginalisation of the Fulani may have far-reaching consequences.

Acknowledgements

The study has been financed by the Ph.D. program "Political and Cultural Institutions in Development" at International Development Studies *(TU)*, Roskilde University. The fieldwork was funded by the Danish Council for Development Research (RUF) for which I am cordially grateful. I have, during the years the project has been underway, enjoyed the interdisciplinary environment at International Development Studies, and I have especially benefited from the way that Ph.D. projects are incorporated in the daily life at the Department. In the light of the reorganisation of the Ph.D. programs that is, and for a while has been, taking place in Denmark leading to a higher degree of "school-ification", I find that it is important for the formation of a researcher and teacher to be a full member of a team.
The study has been formally associated to the interdisciplinary SEREIN program (Sudan-Sahel Environmental Research Initiative) funded by the Danish Council for Development Research (RUF). The study would have been difficult to accomplish without the support of this program with respect to local contacts, accommodation etc. I am especially indebted to Professor Anette Reenberg, Director of SEREIN, for her continued support that I have enjoyed ever since I first started my master thesis at the Institute of Geography at Copenhagen University. Other SEREIN partners I would like to mention are Jens Madsen, Mads Lund and Faho Théorphile, Director Projet PDR/Boulgou.

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Table of contents

List of figures

List of tables

I. Introduction

Agricultural expansion in West African Savannah environments leads to the marginalisation of the pastoralists. Not only does this have negative consequences for animal husbandry as an economic resource, it also prejudices opportunities for further agricultural intensification through the expansion paradox.

This summarises the basic statement of the present thesis: a detailed study of two farmer and pastoralist communities in South-eastern Burkina Faso, using a combination of field observations and investigations and studies of dominant theories and findings in the subject.

The motivation for undertaking this study stems from my first encounter with rural Africa. In the early 1990's, I stayed for three months in a small village in South-eastern Niger, primarily studying crop-cultivation in a harsh Sahelian environment. I had only brief encounters with the pastoralists in the region, as I was based in, and primarily studied, the Manga or Kanouri farming community. However, brief though my encounter with the pastoralists was, it inspired me to study further, as it was clear to me that crop-cultivation could only ensure a relatively low level of subsistence, whereas animal husbandry seemed better adapted to exploit the scarce natural resources. Besides having a personal interest in animal husbandry from having worked physically with cattle in a European and Middle eastern context, I was curious about the situation and the possibilities for animal husbandry in West Africa from a development perspective.

I originally planned to investigate this in the Sahelian northern provinces of Burkina Faso, but after an introductory study in both north and south Burkina Faso, it became evident to me that an accelerated and important development in agriculture and animal husbandry was also taking place in the Soudanian south, and that it had been far less intensively studied compared to the northern Sahelian provinces. Thus, I moved the focus to the savannah environment in Burkina Faso and soon discovered the complexities of the relationship between crop-cultivation and animal husbandry. The division of these activities along ethnic or socio-cultural lines accentuated this complexity. My study therefore takes its point of departure in the possibilities offered by the natural resources for both crop-cultivation and animal husbandry and how this is reflected in the exploitation systems applied by two distinct groups, the Bisa farmers and the Fulani pastoralists. This is very complex and hence difficult to apprehend for an outsider, and I have no doubt that my interpretation is not complete, but on the other hand I believe that through the application of general theories and comparable findings, I have been able to discover patterns concealed from the local practitioners of farming and animal husbandry by everyday routines and personal affiliations. Patterns which may contribute to a better understanding of the complexities and consequences of the present developments.

II. The research questions

In West Africa, from the semi-arid Sahel to the semi-arid and sub-humid Soudanian and Guinean zones, a significant shift in animal husbandry has taken place during the last 3 decades. As part of a new settlement structure, herders have moved from northern Mali (Ramisch, 1999), Burkina Faso (Delgado, 1979b; Howorth and OXeefe, 1999:15) and Niger towards the southern areas of these countries and further on to Côte d'Ivoire (Bassett, 1994b; Bernardet, 1988), Benin, Togo (de Haan, 1998), Ghana and Nigeria (Blench, 1994).
This change has partly been initiated by the droughts in the 1970's and 1980's, a gradual reduction in the tsetse fly populations in the south, and increased use of the plough and the cart in the more agriculture-dominated wetter environments, encouraging integration of agriculture and livestock (Powell and Williams, 1993:26).

The Sahelian pastoralism has thus faced fundamental changes as a result of several complex processes that furthermore have to be understood in their local context due to the large heterogeneity in West Africa. The above-mentioned droughts have been part of this process, and may have acted as triggers of some of the changes that have often been characterised as an actual crisis for Sahelian pastoralism.
Many pastoralists[1] have lost their cattle and have been forced to flee to the cities or southern areas or take up work as herders of other people's cattle. This cattle was often sold at low prices during the droughts to urban-based people, the so-called absentee owners. Migrating pastoralists were forced to settle in marginal areas in the more agriculture-dominated regions, curtailing their opportunities in the crop cultivation they were increasingly forced to adopt and placing them in competition with the local farmers who also expanded the agricultural area. Thus the pastoralist crisis led to a complex socio-economic transformation (Thébaud, 1988:109-110) often leading to further marginalisation of the pastoralists, understood as inferiority in relation to access to resources and local socio-economic influence.

The changes experienced by the Sahelian pastoralists, partly as a consequence of the droughts, have been the subject of intensive debate. Narratives like "desertification", "tragedy of the commons", and the "cattle complex", which have deposited much of the blame for the seemingly accelerating environmental degradation on the pastoralists, have typically influenced this debate.
However, other pastoralist groups have been living a sedentary lifestyle in the Soudanian and Guinean zones for many years and have maintained important complementary links with local

[1] Pastoralists are here defined as a socio-economic and culturally distinct group who primarily are involved in animal husbandry or who traditionally and culturally perceive animal husbandry as their primary concern. In the present study, the pastoralists are synonymous with the ethnic group, Fulani. This is in contrast to the farmers who are primarily involved in crop cultivation or who traditionally and culturally perceive themselves as farmers. In the present study, the farmers are synonymous with the ethnic group, Bisa.

farming communities. One of the most important is the entrustment system, where the pastoralists take care of the local farmers' cattle on short- or long-term contracts. These zones have traditionally been regarded as primarily agricultural regions and the pastoralists have not been studied with the same zeal as their Sahelian cousins. Though these regions are relatively favourable towards agriculture compared to the Sahelian regions their importance as animal husbandry zones has increased with the above-mentioned pastoralist migrations and the increase in animal husbandry among the farmers. Besides, their agricultural potential has only to a very small degree led to an actual agricultural intensification[2] and they are still dominated by extensive subsistence production and agricultural expansion[3] with possible adverse environmental consequences. It has been shown how land-use intensity, human population and livestock density are now strongly correlated, indicating a growing importance of crop-livestock interactions and integration[4] (Bourn and Wint, 1994b).

However, the agricultural expansion initiated by high population growth rates, the introduction of animal traction, and declining yields on existing extensively cultivated fields makes animal husbandry increasingly difficult as grazing areas are being transformed into fields. This is especially problematic during the growing season, when it becomes difficult for the herder to prevent the animals from destroying the crops. At the same time the farmers acquire more animals, partly for use in crop cultivation as animal traction and manure supply, and partly as an investment or saving, a strategy which has become even more popular following the significant price increases on cattle following the devaluation of the CFA franc in 1994.
A direct consequence of this has been that competition over grazing areas, crop residues and watering points during the dry season increases, which may eventually force pastoralists to move away with their herds as they are politically indigent in terms of access to resources and tenure rights. It seems likely that competition over resources and conflicts ignited by crop damages will aggravate tension between the farming community and the pastoralists. This may have a negative impact on the complementary links and especially the vulnerable entrustment system that builds on trust and good relations between the two parties. Because of the complementary links between pastoralists and farmers, and farmers' own interest in having cattle, these processes happen gradually and are very complex. As these zones increasingly are becoming important animal husbandry production zones, an understanding of these processes is necessary both to evaluate their consequences and eventually to identify viable alternatives.

[2] Intensification is here defined as the process where an agricultural production system raises the level of input in the form of labour, manure, in-organic fertiliser, technology etc. and consequently also raises the level of output.
[3] Expansion is defined as an enlargement of the cultivated area into areas that have hitherto not been cultivated.
[4] Crop-livestock interactions and integration have different characteristics, which will be discussed further in a later chapter (page 47).

Although the pastoralists are only a minority in these regions the consequences of these processes may be far-reaching. The pastoralists are specialists and expert herders and are therefore better at maintaining the herds both with respect to finding the best fodder and treating diseases. Burkina Faso as a land-locked and primarily semi-arid country with little agricultural potential enjoys important natural comparative advantages in animal husbandry vis-à-vis the coastal countries that, due to diseases, cannot sustain important livestock rearing. Cattle exports to the urbanised and relatively rich coastal markets are therefore an important economic activity, and one that due to the continued high urbanisation rates is likely to continue. A marginalisation of the pastoralists is likely to undermine this economic potential.

The marginalisation of the pastoralists may also have important consequences in relation to agricultural development. Pastoralists and farmers live as distinct socio-economic and cultural groups and the complementary links represent important interactions between two separate land use systems. These interactions are a locally adapted alternative to an actual integration of animal husbandry in the farming system, where the fanners themselves would maintain the animals on-farm. The most important of these interactions is the entrustment system, which increases the feasibility for the farmer of exploiting the benefits of animal husbandry without sacrificing labour for maintenance of the animals, which would be associated with prohibitive opportunity costs (Delgado and Mclntire, 1982:195). Thus, the complementary links support the mixed farming model through the provision of animal traction and manure, albeit through interaction rather than integration. As intensified agricultural production typically requires the adoption of animal traction through the mixed farming model, a breakdown of the entrustment system therefore may partly explain why farmers have not intensified their agricultural production, even in areas where agricultural expansion is no longer possible. Another important issue is the existing agricultural potential, especially how it compares to regions where successful agricultural intensification has taken place. A further important aspect is the influence of off-farm income that has been shown to be significant in both the Sahelian and the Soudanian zones (Reardon *et al,* 1988; Reardon *et al,* 1992; Savadogo *et al,* 1994), and which may compete with crop cultivation when the farmer is to decide where to invest an eventual surplus.

Thus there are several important implications of the ongoing changes in the rural Soudanian zone. The present study will analyse some of these complex processes with a point of departure in a region in South-eastern Burkina Faso. The key question investigated is:

If increased competition over the natural resources is happening, partly caused by agricultural expansion, how then is that affecting the animal husbandry of the sedentary pastoralists, and what are the consequences for the links between the pastoralists and the farming community, formerly characterized by some complementarity?

bio-physical and socio-economic environment. Second, that there are problems inherent in the theories themselves that may prevent a thorough understanding of the processes observed. These have to do with the way that agricultural expansion is perceived as an integral part of agricultural intensification, which, I argue, is not an adequate reflection of the realities observed. Without a distinction between agricultural expansion and intensification, it cannot be explained that the agricultural expansion may in fact work against intensification instead of being an essential precursor of this process. One of the main points of the dissertation is that this is especially important when distinct cultural and socio-economic groups are dependent on the same resources, as expansion in one system may then lead to marginalisation in the other. In relation to this I introduce the concept "the expansion paradox" which I argue may partly explain the tendency for farmers to expand their agricultural areas rather than to engage in an autonomous intensification process.

Furthermore, I take a critical standpoint in relation to the debate on narratives in development research. Several narratives are relevant for the processes occurring in the selected research area, and while the debate on narratives have provided valuable new insight, it also has an inbuilt danger of evolving into a dichotomy of narrative - counter-narrative that I find less rewarding.

Thus, my ambition with the present study is to contribute to an improved understanding of the changes going on among the sedentary pastoralists of the West African Soudanian zone, and to show that these changes are not simply a matter of a minority being marginalized but do, in fact, have far-reaching consequences for the feasibility both of agricultural development in the form of intensification, and animal husbandry as one of the few economic activities for which Burkina Faso has an important economic potential. Furthermore I wish, through the application of the above-mentioned theories, to clarify the complicated interplay between the preconditions for agricultural intensification, the consequences of agricultural expansion through the "expansion paradox", and other opportunities influencing local farmers' natural resource management. It is my hope and belief that such an improved understanding may contribute to an enhanced guidance of development assistance to reduce poverty.

The region studied is the Boulgou province in South-eastern Burkina Faso. The region is situated in the Soudanian agro-climatic zone and can be characterised as a transition zone. To the north is the arid and semi-arid Sahel, dominated by extensive grazing systems and the cultivation of millet during the rainy season. To the south is the sub-humid to humid Guinean zone with a longer agricultural season, more favourable dry-season cultivation, and animal husbandry, either more intensive with little migration or absent in disease prone areas.

A more specific set of sub-questions will be guiding this investigation:

- Is there increased competition over natural resources?
- Is agricultural expansion taking place, and if so why?
- In case of increased competition, what kind of conflicts arise between farmers and pastoralists and have they been escalating?
- How does this affect the herd management of the pastoralists?
- Is the entrustment system being affected negatively?
- What consequences do these issues have for agricultural and pastoral development in the region?

The research consists of a detailed analysis of two selected pastoralist settlements and the associated neighbouring farming communities. The investigations consist primarily of interviews and discussions with the local population. Thus, the point of departure is two cases that illustrate the processes described above.

One common problem of this kind of research is how to generalise from a heterogeneous reality. The environment and the societies in Soudanian-Sahelian West Africa are characterised by a high degree of heterogeneity. The basic problem is, therefore, how to extract from this diverse pool of examples a more general knowledge that may also be applicable to other environments or at least to other regions with somewhat similar environmental or social characteristics.

In order to attain an understanding of these complex relationships that reach beyond the two specific villages, a theoretical framework is applied. This framework not only permits a higher level of generalisation, but has also guided the analysis of the primary data. I have drawn heavily on the theories of the Danish economist Ester Boserup, not because she happened to be a compatriot, but because her ideas are relevant for the local processes of agricultural development and because her work is very influential in contemporary perceptions of rural development and in policy formulation and development initiatives. Thus, my approach is essentially inductive and based on local observations and as such does not take its point of departure in a specific theory that is subsequently tested. My primary ambition here, is to gain a comprehensive understanding of the processes of change in the chosen location, which may also be relevant for similar regions. However, as will become apparent, my findings also give me an opportunity to speculate about the applicability of this specific theoretical framework in a West African Savannah environment, which may lead to a better understanding of the premises for using these theories and thereby improve their explanatory force.

This is concerned with two aspects. First, that the preconditions for the application of the theories have to be taken into consideration. This may appear self-evident, but it is nevertheless apparent that the ideas of agricultural autonomous intensification, which have recently proven successful in an East-African environment, are often transferred through policy and development initiatives without due consideration to their applicability in a markedly different

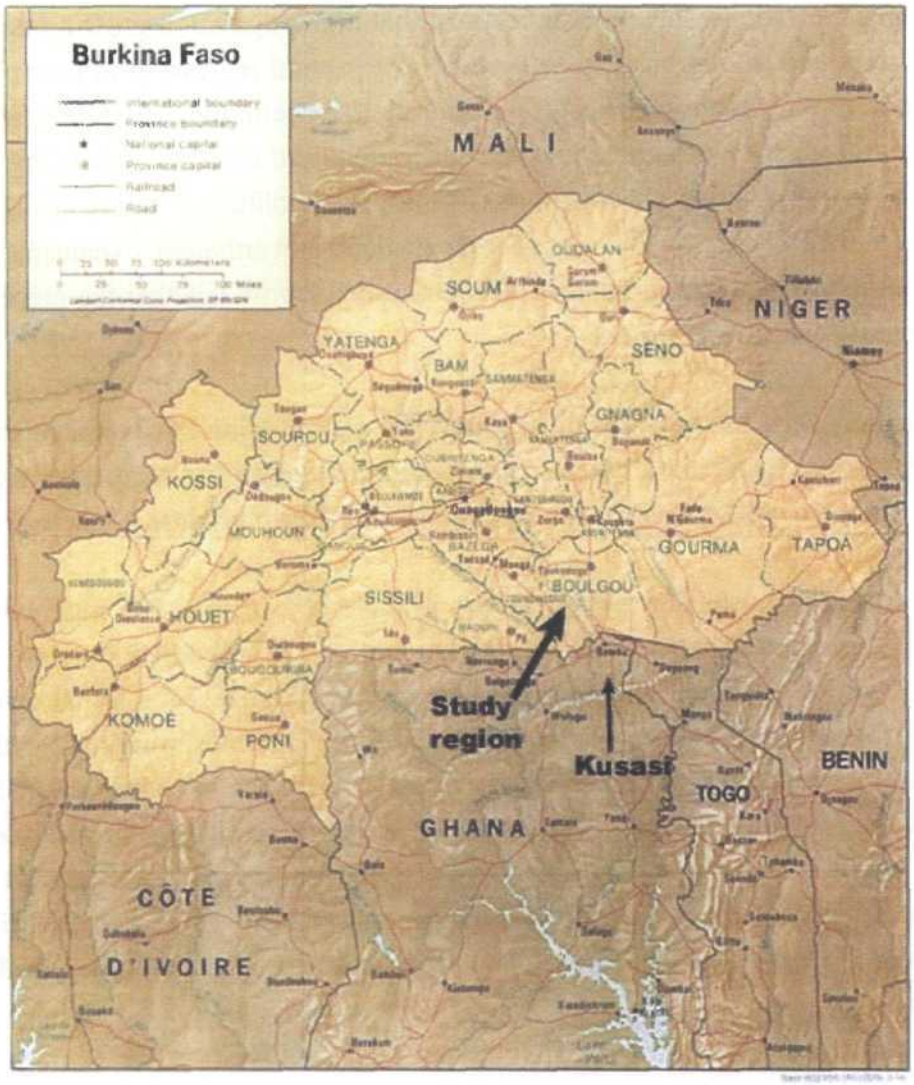

Figure 1 Map of Burkina Faso with the study region

The Boulgou province has a mean annual precipitation of 763 mm (1980-1996) and a growing season of between 150 and 180 days (McMillan *et al.*, 1993). This makes millet, sorghum and to a lesser extent groundnut important crops in an extensive production environment with animal husbandry as an important aspect of the agricultural potential. Poverty is widespread among all population groups and most farmers are not self-sufficient in grain. The region offers relatively favourable bio-physical conditions for animal husbandry due to more stable water accessibility and the existence of grazing resources allowing for some degree of transhumance and selective utilisation of the natural resources. The advantages of interaction with the crop-farming systems of the Bisa and Mossi farmers in terms of manure supply, residue grazing, animal traction, and entrustment are also important factors.

However, the region is undergoing changes that render the future of animal husbandry uncertain. Although the debate on narratives in development research has emphasised precaution of

applying simple causations, there are indications that high population growth rates due to elevated births rates and immigration, together with the general regression in precipitation, have led to deforestation, degradation of natural resources and declining yields. Reinforced to some degree by the introduction of animal traction, the agricultural areas are expanding rapidly, and elements of an intensification process in the form of the abolition of fallow and more consistent use of manure and crop residue has become evident. Nevertheless, expansion is the dominant agricultural development in the province, and it is doubtful whether the preconditions for successful intensification are present.

Animal husbandry will be the point of departure for a discussion of several related subjects. Animal husbandry is understood here as the breeding, fattening and herding of animals of all types, from camels to turkeys, but with an emphasis on cattle because of their economic importance locally.
At least three animal husbandry systems exist in the study region. The interaction between them and the significance both of this interaction and of the individual systems, are complicated issues that are undergoing constant change due to external and internal conditions. As the animal husbandry of the sedentary Fulani pastoralists is the most important with respect to the agricultural development of the region, they will be the principal group studied. However, as the Fulani are primarily sedentary and have a high degree of interaction with the local Bisa farmers, the animal husbandry of the latter will also form a natural and important part of the research. The subject of intensification and expansion is closely linked to the Bisa farmers, hence animal husbandry and the Fulani cannot be analysed separately, though the research focuses on this.

The generally high degree of bio-physical, socio-economic, and cultural heterogeneity in West Africa put up limits for the applicability of the findings to other regions. However, as will be discussed more in detail later, it can be argued that the research area is at least to some degree representative of the West African Soudanian Savannah region where farmer and pastoralist groups coexist and exploit complementary links.

Certain issues that have not been studied in detail, and certain methodological choices limit the validity of the research. The omissions relate particularly to the farming communities as the focus is on the pastoralist groups. These limitations concern the explanation of farmers' decisions in relation to natural resource management, while the pastoralists have been more thoroughly covered.
At least four limitations influence the results of the present study. The first and most serious of these is probably the lack of a detailed study of the off-farm activities of the farming communities. Though it has been included to some degree, practical limitations meant that its significance for the farmers' natural resource management decisions has not been fully covered. This may have implications for the analysis of the feasibility of agricultural intensification in

the area and will be further elaborated upon in the analysis and conclusions. Second, detailed studies of the labour economy of the farmers' households have also been partly left out due to practical constraints. This may also influence the validity of the findings in relation to the feasibility of the farmers' intensification and adoption of animal husbandry. However, older secondary sources provide a thorough insight into this issue and their present day validity is evaluated in the analysis. Third, detailed tenure analyses have not been conducted. The issue was touched upon during the interviews, and recent secondary sources have provided an overall understanding. Although detailed tenure information in the case villages is unavailable, the consequences hereof especially for the pastoralists is known, and this omission is therefore not expected to influence the results significantly. Fourth, the methodological choices and limitations are important and will be further discussed in the methodological sections.

The dissertation is organised in 5 major sections and a conclusion. The first will account for the basic methodological approach and discuss the implications of the choice and application of methods for the validity and reliability of the findings. This is followed by a section outlining the theoretical framework of the dissertation and a discussion of the applicability of the theories used in the present study. Thereafter, the study region is described, thus providing the local context for the ensuing analysis of primary data. The analysis is preceded by an account of the fieldwork methods used to acquire the primary data. The analysis is divided into a section dealing with the Bisa farmer villages and one dealing with the Fulani pastoralist villages. The conclusion outlines the findings and relates it to the theoretical framework. Finally, some major limitations of the study are discussed and policy considerations are provided.

III. Research methodology

The purpose of the following chapter is to give an account of the methodological approach applied. Together with a more detailed account in chapter V of the specific methods used it is intended to provide a basis for evaluating the reliability, validity and replicability of the study.

A. The nature of the information sought

The research is based on the primary empirical data collected during the fieldwork. Not only does primary empirical data provide new, locality-specific and more general information about a certain subject that may be impossible to acquire from secondary data; but development research has to relate to the often very complex and constantly-changing realities in developing countries that may only be understood through presence.

The research focuses on land use systems at both village and household level. The village level allows for a broader outline of the combinations of exploitation systems and the management of the resources, while the household level provides in-depth data on the actual exploitation system applied, and on the specific situation of the individual.

The data gathered are varied. The basic, more descriptive data, are predominantly quantitative. They include information on the household and herd sizes and composition, the economic activities of the households, the labour uses, the basic characteristics of the villages and the natural resources available. This kind of information has been gathered primarily through semi-structured interviews, questionnaire surveys and observation.

However, the bulk of the data are more qualitative and consists of the respondents' perception of their situation, their environment and the opportunities that are available to them. As this kind of information may be incoherent and complex it demands an adaptive methodology that responds to the individual respondent and the specific interview situation. The main tools used for these data have been open-ended semi-structured interviews, observation and various PRA (Participatory Rural Appraisal) techniques.

B. Methodological approach

It has been the aim to collect information that is as reliable and valid as possible. There are, however, several pitfalls and problems related to this among which the objectivity of the research is particularly salient.

For the research results to be reliable and valid, the information gathered must as far as possible reflect the realities of the subjects. This means, first and foremost, that the researcher is obliged to take into consideration circumstances that may influence the findings. This could be the common biases like roadside-, person- (elite-, active-, male-), season-, diplomatic- and

professional-biases (Chambers, 1984:13). All these must be taken into consideration when selecting research sites and respondents.
Another common problem is the distortion of information that arises from deliberate or unconscious misinformation from respondents. This important source of error can be very hard if not impossible to detect, and only an intimate knowledge of the local community, its culture and embedded social relations may help in this respect. This requires long stays in the local community which are difficult in the framework of a Ph.D., so that cross-checking, triangulation, posing the same question formulated differently in another context, and vigilant observation have been the primary means to counteract this source of error.

However, the major source of error may very well arise from the researcher and his assistant themselves.
When working with an interpreter, I normally prefer a less well-educated person, as I have the experience that the more schooling the interpreter has had, the more he listens to his own voice instead of the voice of the respondents. A similar criticism could equally apply to the researcher himself, and even more so. No matter how much energy and consideration is put into counter-measures against the above-mentioned biases and errors, they are not likely to affect the errors that arise from the researcher's own misinterpretation. A roadside bias for instance is an "external" source of error that relatively easily can be recognised by the researcher by plotting the households on a map. But the "internal" error is harder to recognise, for instance when the researcher is so absorbed in the pursuit of a specific problem that is important in his mind that he overlooks a problem raised by the respondent that may be much more important. This is what I basically understand by the subjectivity problem, which again is closely related to the replicability of the research.
There can be no doubt that the subjectivity of the researcher is a major factor when talking about complicated issues like integrated farming systems, as anthropological and participatory research necessarily imply some kind of intervention into the lives of the local actors, or an expansion of the life-worlds of both the researcher and the respondents (Seur, 1992) sometimes in ways that the researcher has no way of knowing. Hence, replicability is only possible to a certain extent. Some anthropologists argue that the consequence hereof is that no research can be objective, so a purely subjective interpretation and presentation of the subject is legitimate (Hastrup, 1988). However, through a detailed account of methods used, obvious biases and error sources, the judgement of the reliability of the research is at least made open to the reader, though its replicability may still be questioned.

The scale used is village and household level. Focussing on the micro level as is done here carries the risk that outside relations and influences may be overlooked. For example when studying the village and the village territory it may be overlooked that a large part of the population may have migrated, so the situation of the present villagers may not reflect the situation of the ones who were forced to leave, thus disturbing the picture of their livelihood opportuni-

ties. This is one of the points of critique that has been raised against the Machakos study in Kenya, as will be discussed later (page 41). One specific problem of the choice of scale in the present study area is that the transhumant pastoralists are not included. For practical reasons it was not possible to include this group in the study, with the risk of overlooking an important part of the animal husbandry in the region. The only references to this group are made through statements by local farmers, sedentary pastoralists, and extension staff. However, this was a limitation I was forced to accept and the findings presented here therefore cannot be valid for pastoralism in the region in general, but only for the animal husbandry performed by the local sedentary farmers and pastoralists.

The present study focuses on the land use systems of the local population. One common approach to such a field of study is farming systems research where a relatively narrow focus is kept on production systems, while other means of subsistence open to the local population, such as migration work, trade, handicraft etc., are seen as external to local agricultural production systems and are not included.

However, in relation to the study of dynamic farming systems, e.g. in a process of agricultural intensification, the use of a farming systems approach could have the implication that the techniques used in the system are seen as a whole rather than a set of techniques used as a response to specific conditions which may also lead to simplistic policy formulations or norms of modern and traditional hence backward farming techniques. Another problem of using a farming systems approach as opposed to e.g. livelihood studies is that the importance of non-farm activities and external factors influencing the lives of the peasants may not be captured. Several studies have revealed the importance of non-farm income for the farmers in arid and semi-arid environments (Reardon *et al,* 1988; Reardon *et al,* 1992; Savadogo *et al,* 1994) as will be discussed later, and by using a more holistic and interdisciplinary approach as facilitated by livelihood studies, both the productive and reproductive rationales of household decisions may be captured (Birch-Thomsen *et al,* 1999:4). Also the terms of access to and control over resources are crucial for the household strategies and as such livelihood studies may be seen in connection with the political ecology approach as propagated by a.o. Blaikie (1985).

The present study has its natural focus on the farming systems of the pastoralists and the peasants but it does not only apply a farming systems approach. The pastoralist and farmer households in the present study area are seen as units composed of members with different possibilities and roles of which some may be related to activities other than farming. These activities must be seen as an integral part of the farmers' livelihood as they may be determining for the resource use and the decisions taken in a household in relation to farming or animal husbandry activities. Not all areas have been covered sufficiently in the present study because of time constraints and other limitations, but to the degree it was practically possible and they were deemed relevant, they have been included rather than maintaining a close focus on agricultural and animal husbandry-related activities. The purpose of this has not been to follow a specific model regarded as appropriate but rather to reach an understanding of the possibilities

offered to the individual household. The present study therefore may be neither a typical example of farming systems research nor a typical livelihood study but rather something in-between guided by practical limitations and an in-situ evaluation of the relevance of various activities and issues.

The timeframe of the study is another major point of concern. Incorporating historical data into research is a major point of critique often found in relation to the debate on narratives in development research (page 72). The fieldwork was primarily conducted during a single season and therefore has the obvious risk of providing merely a "snapshot" of reality in Boulgou, shaped by the conditions of that specific year or season. As one of the main ambitions of the study is to reveal development changes other methods had to be applied. First, through selection of the villages studied, an attempt was made to reveal a trend in local development dominated by increasing density of cultivation and its inherent consequences for pastoralism. Second, through interviews the present situation of the respondent was put in a historical perspective by making comparisons over time. The ability of the respondents to recall past conditions is, of course, good, though memory tends to be selective and various biases had to be taken into consideration. Third, secondary sources of varied character and quality were used to compare the present-day findings. Fourth, the visible changes were studied through comparison of 20 year old and contemporary aerial photos. However, due to time constraints this material has only superficially been exploited.

Thus, scale and time have been given much attention during the gathering of information and the analysis, and it is my perception that the choice and comparison of the two village societies also allows a comparison over time, justified by the presentation and analysis of comparable data. This is made possible through applying a comparative research design, which will be elaborated upon in the discussion of field work methods applied in chapter V page 86.

Another problem with this kind of research is the inconsistency of the theories and the complicated nature of the problems. Which theory to chose and how to apply it? All the problems are interrelated in such a way that defining a single problem and setting up theoretically-based hypothesis becomes a matter of choosing the point of view, the theories to apply, and the delimitation of the problem, thereby consciously neglecting some aspects of the research object. In classical deductive scientific methodology as often used within the natural sciences, a specific problem can be studied by testing measurements and observations formulated as a hypothesis against a theory of already proven relationships and correlations. In the following I provide an example of such a classical approach. It is not concerned with natural resource management at all, but in its simplicity I find it illuminating.

This case[5] is concerned with the genealogical evolution of man. The question is whether modern man descends from the Neanderthal or whether the Neanderthal was a blind branch of evolution. The Neanderthal descends from *Homo erectus* who also is the ancestor to the later Cro Magnon and today's humans *{Homo sapiens).* It is however, uncertain whether the Neanderthal developed along the Cro Magnon - *Homo sapiens* path, or whether the Neanderthal represents a separate evolution, and is thus not an ancestor to present day humans. A bone from the ear, called the bony labyrinth, found on several archaeological sites, shows specific features characteristic of the different hominids. As these specific morphological features of the bone are fully developed before birth, comparisons can be made across adult and non-adult specimens. Now, if the Neanderthal was an ancestor of Cro Magnon and modern man, it would be expected that the bony labyrinth would show a morphological continuity from *Homo erectus* towards the bone in modern man.

Thus we have here the formulation of a hypothesis that can be tested by simple measurement and statistical analysis. The hypothesis is based on the experience from many years of archaeological work showing correlation between the derived features of the bony labyrinth and the evolutionary stages of hominids. A clear and consistent deductive argumentation.

It turned out that the derived features of the bony labyrinth from the Neanderthal were significantly different from what could be found among the *Homo erectus,* Cro Magnon and modern man. It could therefore be concluded that the derived feature of the bony labyrinth supported the theory that the Neanderthal was a specie apart from *Homo sapiens* having developed along a path divert from *Homo erectus* suggesting a biological barrier between the contemporary Neanderthal and Cro Magnon man.

However, when working with complex social systems where numerous social and environmental causes have varying influence on the strategies chosen it is difficult to define a single hypothesis (Blaikie and Brookfield, 1987:239). Because human behaviour is dependent on so many different variables and circumstances the theories within this field are not deductively powerful and may not be tested under controlled conditions. This is unlike many natural science fields where independent variables can be controlled in an experiment and the dependent variables studied through testing hypotheses deducted from relatively simple or less multidimensional theories as illustrated in the above case. Rather, in social and political science several hypotheses are needed, and as Holt and Turner (1970:6) states for political science it is furthermore doubtful whether a clear testing of such hypothesis is possible at all.

> *"The theoretical structure in political science is not deductively powerful, and hence the rigorous deduction of hypothesis is, with few exceptions, impossible. "(Holt and Turner, 1970:6)*

[5] The following case is based on an article in Nature by Hublin et al. (1996)

As I use a basically inductive approach, and in acknowledgement of the above-mentioned difficulties, I have chosen not to try and test a set of hypotheses but rather to work with a number of guiding questions. As mentioned I have chosen a theoretical framework that to my knowledge is relevant and has a high degree of explanatory power, yet may not be fully applicable to the present study area and may not provide the foundation for a proper testing of hypotheses. By so doing I aspire both to theorise the context-dependent observations and contribute to the development of applicable theories in a West African Savannah environment. These theories will be presented and discussed in the following chapter.

IV. Agricultural intensification, mixed farming, and the expansion paradox

The following chapter discusses some theoretical issues related to the present study. The purpose is to go beyond the local context and relate the findings to a more general discussion on agricultural development. Without such a discussion, the findings will only have value in the local context and are therefore not likely to contribute to a better understanding of the dynamics of agricultural development. By making abstractions to, a broader understanding is gained of the development trends in the study area, as well as an idea of the applicability of the theories used and possible modifications hereof.

The following discussion focuses on a model of agricultural intensification developed by Ester Boserup and the discussion on mixed farming. These models are relevant for the present study area as they may help to understand some of the development trends that can be observed, and as they are strongly influencing local policy decisions and development initiatives.

However, the Boserup intensification model cannot simply be transferred to the local context. It is shown that, contrary to the Boserup model, intensification and expansion must be seen as distinct processes, especially when more than one land use system is dependent on the same resources. If expansion is seen as an integrated part of intensification in one system it is overlooked that the same process may lead to abandonment in another. As will be illustrated in the study cases, this may lead to the expansion paradox where, instead of acting as a forerunner for intensification, agricultural expansion has negative implications for further intensification and agricultural development.

There are also certain preconditions that must be fulfilled before the intensification process can be expected to take place. It is argued that population density is not the only factor that may trigger agricultural intensification, but that a certain potential is critical for successful intensification. This may also help explain the present development trend in the study area and the prospects for agricultural intensification.

Finally, narratives in development research will be discussed with a specific focus on "desertification" and the "new ecology", the "tragedy of the commons", and the "cattle complex", as they are relevant to the present study.

A. Defining and measuring intensification

Intensification is a very central term in the character of a given agricultural system and has often been used as basic criterion for the classification of land utilisation systems (Christiansen, 1992:55; Ruthenberg and MacArthur, 1980:14). However, intensification has several meanings depending on the context in which it is being used, and its role in the development process is far from unambiguous.

> *"Any classification of the systems of land use with respect to the degree of intensity is necessarily arbitrary to some extent" (Boserup, 1965:15)*

Intensification implies an increase in expenditure including labour on units per area cultivated in order to attain higher productivity per unit area (Hiernaux, 1994:23). This may also be paraphrased as a measure of the total output per unit area and time (Kates *et al,* 1993:12), that is, it is closely related to the productivity of the land. Intensification should not be seen as an end product, a static condition that a system has acquired, but rather a process, a development with certain basic characteristics, that a system is going through.

The productivity of the land, however, is not a straightforward measure of intensification. This has to do with the complicated nature of the African rural household. The output of different crops is not readily comparable as it depends on whether the variable is economic value, nutritional value i.e. calories, or the pure weight of the harvest. The fields may have multiple functions i.e. staple crops, trees, and livestock stubble grazing, mixed cropping may be used, and the timing of the cultivation may be inconsistent. A possible solution to this problem could be to standardise the output to e.g. a staple-food equivalent, however, the data needed to make an assessment on intensification based on this criteria will seldom be present (Kates *et al,* 1993:12).

As will be discussed later, Boserup redefined the concept to focus on *"the gradual change towards patterns of land use which make it possible to crop a given area of land more frequently than before"*(Boserup, 1965:43). This should be seen in the context of a general perception of the evolution of farming systems, where shifting cultivation with forest-fallow evolves into bush-fallow and later grass-fallow as the frequency of cultivation of the fallow fields increases and eventually only grass vegetation is able to establish itself (Boserup, 1965:20; Pingali *et al,* 1987:26). The final stage in this evolution is annual permanent cultivation, multiple cropping and further increased investment levels of work, capital and auxiliary inputs.

Despite the complications that may arise from the application of multiple cropping, the use of different fallow practices simultaneously, and the presence of perennial crops not requiring planting or harvesting within a normal cultivation cycle, frequency of cultivation is a fre-

quently used measure because of the relative ease with which data can be obtained (Kates *et al*, 1993:14).
Furthermore it can be made into a standardised factor that can be calculated in general terms. One example hereof is the R-value, used by Ruthenberg (1980:15) to determine the frequency of cultivation and thus classify the farming systems. The R-value is defined as the number of years of cultivation (multiplied by 100) divided by the number of years of cultivation plus fallow, that is the total length of one cycle of cultivation, and it indicates the proportion of the area under cultivation in relation to the total area making up the farming system. Accordingly, shifting cultivation would have an R-value of around 10, while a cultivation system is considered permanent at an R-value of over 66. In a multiple cropping system, the R-value will exceed 100 i.e. 300 for three crops a year.

However, some caution should be applied when using fallow as an indicator of intensification as fallow is not unambiguous. The rationale for practising fallow may vary with the agro-ecological and socio-economic context. In case of scarcity of land, a farmer may be reluctant to let some of his fields lay fallow out of fear that he will loose the usufruct right to the land even though he will not be able to invest the necessary work in the field to gain a significant harvest (Jean, 1975:39). The rationale for not using fallow will in this case be related to the local tenure system rather than actual increased production. Hence, reduction in fallow in this case will not be an indication of intensification as there is no real increase in investment or productivity of the land.

In addition, cultural factors may be determining for the practice of fallow. Goldman (1993:262) shows how the change from group rotation system to individual fallow in southern Nigeria was partly determined by cultural factors, and in semi-arid regions frequent fallowing may be essential to store sufficient moisture in the soil to produce a crop (Grigg, 1979:77).
The availability of family members for agricultural work may be another factor influencing the decision of whether or not to fallow. Migration or illness in the family may severely affect the area that can be cultivated, thus increasing the area left fallow. Lack of hands or physical force to do the clearing of a field previously under fallow or of virgin land may prevent the farmer from leaving a low-yielding field and starting a new one. Fallow fields that have been heavily grazed may have thick bush vegetation, especially those species that livestock do not browse (Ruthenberg and MacArthur, 1980:102), thus further demanding substantial labour for clearing. This could result in a decreasing R-value which should indicate a process contrary to intensification even though the actual population density may in fact be increasing.

Another possible measure of intensification is the combination of technologies being applied. This must again be seen as an acknowledgement of the Boserup-model, where technological innovation is part of autonomous intensification. However, technology in an African rural context is not unambiguous as highly intensive systems with elevated labour input may in fact

be very low-technological. Besides, many creative adaptations of technologies or procedures are common that may not be defined as technological innovations (Kates *et al,* 1993:14).

A combination of the above-mentioned indicators may be the most appropriate measurement, as demonstrated by Michael Mortimore. In a study in Northern Nigeria, he used both frequency of cultivation, labour intensification per hectare and capital intensification per hectare as indicators of the intensification process (Mortimore, 1993a:42).
This combined definition is coherent with the more commonly-used indicators of changes in crop rotation, reduced fallow and new technologies like ox-mechanisation and improved seeds (Bassett, 1994a: 15). A broad study of the intensification based on official UN statistics, very much like the 1981 study of Boserup, used a combination of decrease in fallow, increase in irrigation, increase in multiple cropping, and the level of chemical fertiliser use (Bilsborrow, 1987:190, 194) and Hunt (2000:263-267), used land area, technology, labour input and yield to compare intensification in Southeast Asian rice farming systems.

The present study does not attempt to measure the degree of intensification in the study area, hence a precise definition of intensification in terms of measurable variables is not called for. However, the definition of intensification is significant as it is seen as a process different from agricultural expansion. As will be discussed in subsequent sections, a clear distinction between agricultural intensification and expansion is maintained, because in the study area an inclusion of expansion in the intensification process would not capture the consequences that the enlargement of the agricultural areas has for land use and the development process. As a consequence intensification is here defined as an increase in capital and labour investment per area and hence increased production. More frequent cultivation of fallow land is thus a part of intensification, and fallow land is understood as previously-cultivated land that is part of a fallow rotational or other system.
This is in contrast to expansion which is defined as the cultivation of land that has hitherto not been cultivated, so the reopening of fallow land is excluded from expansion. Other uses of the land like grazing, hunting, gathering etc. are seen as exterior to the agricultural system and the opening of cultivation in such areas is therefore defined as expansion.
Extensification is defined as the opposite process of intensification, that is, a decline in input and labour investment per area and hence a declining output. Expansion can imply extensification, and extensification can take place without expansion. As the focus is on the enlargement of agricultural areas, this study will operate with the more precise term expansion rather than extensification.
Agricultural expansion and intensification are distinct processes with different characteristics and hence may not lead to development in the same direction. This difference will be treated in more detail in the next section.

B. Intensification as a development model

Intensification and population growth are often spoken of in the same breath. Though intensification may be driven by other factors, increased rural population density is often considered to be a major trigger for it. An increasing population in a given area invariably leads to greater demand for food, which is likely to lead to the inclusion of more agricultural land and more intensive use of the land already under cultivation.

Two scenarios of population growth and development have dominated this debate. A rather pessimistic scenario was presented by the British priest and economist Thomas Robert Malthus in successive works from 1798 to 1824. The basic thesis was that population growth was characterised by a geometrical (exponential) ratio while subsistence (that is the ability to produce food) only could increase at an arithmetical (linear) ratio (Malthus 1798 in Wrigley and Souden, 1986:Vol.I,15). Hereby subsistence would invariably quickly fall behind population growth if this was not checked. But even with the more or less natural checks on population it would still result in emigration *"which necessarily implies unhappiness of some kind in the country that is deserted'* (Ibid.: 13). This unhappiness (for the lower classes) is accentuated by the unfortunate coincidence of market forces, resulting in low prices for labour and high prices for provisions.

The Malthus or neo-Malthus model that Malthus became the founder of, predicted that increased population would lead to increased demand for food, which would increase the cultivated area and reduce the length of fallow. This would then eventually lead to declining soil fertility and yields, with environmental destruction and food scarcity as direct consequences. This perception of the relationship between man and his environment implied that a given resource is characterised by a fixed carrying capacity, and that going beyond this threshold will eventually lead to over-exploitation which will result in degradation and starvation and hence limit population growth. Population growth is therefore seen as a dependent variable of agricultural production and therefore, with minor modifications, of the environment, as it is the produce of a given piece of land that will determine the population that can live of it.

> *"Their (Malthus and his more or less faithful followers) reasoning is based upon the belief that the supply of food for the human race is inherently inelastic, and that this lack of elasticity is the main factor governing the rate of population growth. Thus, population growth is seen as the dependent variable, determined by preceding changes in agricultural productivity which, in their turn, are explained as the result of extraneous factors, such as the fortuitous factor of technical invention and imitation. "(Boserup, 1965:11(parenthesis added))*

Population growth is, therefore, a danger to mankind, a notion that has a long history and that also today can often be found paraphrased in the media.

Yet Malthus did not overlook the possibilities that lay in what we later have termed intensification and agricultural expansion. He states, concerning a situation of surplus population, that:

> *"In the meantime the cheapness of labour, the plenty of labourers, and the necessity of an increased industry amongst them, encourage cultivators to employ more labour upon their land; to turn up fresh soil, and to manure and improve more completely what is already in tillage; till ultimately the means of subsistence become in the same proportion to the population as at the period from which we set out" (Malthus 1798 in Wrigley and Souden, 1986:Vol.1,15)*

This statement corresponds closely to current definitions of intensification and also mentions the process of expansion, and suggests these initiatives are sufficient to counteract the adverse effects of the population growth. However, Malthus saw this as merely a temporary cessation on the inevitable path towards unhappiness as he continues:

> *"The situation of the labourer being then again tolerably comfortable, the restraints to population are in some degree loosened; and the same retrograde and progressive movements with respect to happiness are repeated." (Ibid.)*

This then, would result in some sort of oscillation that has been less than obvious due to its appearance among the lower classes who have not been covered by historians with quite the same zeal as the upper classes.
Thus, Malthus did not deny that improvements could be made to the soil whereby the carrying capacity could be increased. Towards the end of his 1798 essay "On *the Principle of Population",* in which he becomes increasingly theological, one can read:

> *"The supreme Being has ordained, that the earth shall not produce food in great quantities, till much preparatory labour and ingenuity has been exercised upon its surface" (Ibid.: 126)*

The limitations of his arguments are therefore not to be sought in lack of considerations of productivity enhancements. Rather, the weighting of the beneficial effects hereof and the demand created by population growth may have been different from what one would have done today. Considering the technological stage of his era, this conclusion may not be so surprising.

However, it is important also to understand the context in which Malthus wrote his essays. Malthus was not so much arguing in terms of a natural law, but was rather taking part in a debate concerning the right way to treat the poor of British society. The debate was focussed on whether the parish laws and the hunger relief programs were in fact detrimental to the poor as they led to continued breeding and thereby overpopulation. Hunger was seen as the only thing that could motivate the poor to undertake hard work and a relief of their burdens would merely lead to overpopulation and aggravate the problem (Ross, 1998). Thus, the ideas of

Malthus that are generally perceived of as a kind of natural laws were originally conceived in a discussion on social policy. The political context of the time which formed his ideas is normally not considered and this may have consequences for the relevance of these ideas in today's discussion on development theory.

As is often the case in general theorising, the original ideas of one person or period are being adapted to give meaning in another era, society, or environment. A more modern interpretation of Malthus developed during the 20th century and was named neo-Malthusianism.

> *"The neo-Malthusians collect all the evidence on the misuse of land and paint a picture of the world as a place where growing populations are pressing against a food potential which not only is incapable of increase but is even gradually reduced by the action of these growing populations. "(Boserup, 1965:21-22)*

This approach is more elaborate on ecological issues like carrying capacity and environmental degradation, including the desertification debate, but is still based on Malthus' assumption that population growth will outrun the carrying capacity of the land. The neo-Malthusian view is important because it has a considerable impact on today's ideas about development work, and it provides a contrasting background to the theories of agricultural intensification which form a central role for an understanding of the processes of change that are taking place in the present study area.

One and a half centuries after Malthus wrote his notorious essays, the Danish economist Ester Boserup considered some of the same mechanisms as Malthus, but in another era and hence with a quite different degree of confidence in the capabilities of technology and innovation.
The now classical work of Ester Boserup from 1965, *"The conditions of agricultural growth"*, represented an alternative to Malthus in providing a positive scenario of population growth. Here, technical innovation as a result of agricultural intensification was considered to be sufficiently important to outweigh the declining yields that would otherwise follow reduced fallow and declining soil fertility. Although this does not necessarily render superfluous the concept of carrying capacity, it provides it with a certain flexibility, as carrying capacity should be seen as a function of the technology applied. There will still be a limit to the productive capacity of the resource, and degradation may still occur, but technical innovation will, through more or less autonomous processes also involving increased market integration, be able to keep up with the elevated demand for food brought about by population growth.
By establishing these relations Boserup offered an alternative to the then-dominant view:

> *"Where (in the English-speaking world) for the most part it was assumed that population growth could only occur if there was an increase in the food supply; this in turn was seen as a result of either an expansion of settlement into uncultivated areas or of some technological advance that increased crop yields. " (Grigg, 1979:65 (parenthesis added))*

With increasing rural population density the need for cultivating a larger portion of land will also increase, and long fallow periods give way to short (grass) fallow periods, annual cultivation and, when feasible, multicropping (Mortimore, 1993b: 16). However, the transition to shorter fallow is not as simple as it might seem. Boserup (1965:32) points to a rather important implication of going from forest-fallow to short bush-fallow. This includes cultivation of larger areas, shift from an emphasis on root crops to cereals because of the labour-demanding weeding of root crops, and a decline in output per man-hour.

The last factor, the output per man-hour or labour productivity, is an important factor to consider with the increased frequency of cultivation. As more work is invested into the same land, the output per working hour will decrease because of diminishing returns to labour. In other words, the farmer has to work increasingly harder or longer in order to gain an increase in harvest (Boserup, 1965:33, 43; Netting, 1993:108). This would, according to Boserup, be true for all the stages from forest-fallow to short-fallow and eventually to irrigated permanent agriculture which has the highest labour requirements of them all. The major reason is that the shortened fallow periods leads to decreased yields which must be compensated by labour intensive techniques. An exception could have been the introduction of leguminous nitrogen-fixating crops whose contribution to yields may have offset the decline in labour-productivity resulting from the change from natural to produced fodder for draught animals (Boserup, 1965:38, 41).

The assumption of diminishing returns to labour is however one of the major points of criticism of Boserup as it is seen as dubious whether the introduction of new technology would not increase the production sufficiently to outweigh the extra work invested (Grigg, 1979:71). By staging the assumption of diminishing returns to labour Boserup limits the validity of her thesis to pre-industrial societies, as modern technology like hybrids and artificial fertilisers would outweigh the extra work invested and lead to increased labour productivity. However, even in a pre-industrial context there is much uncertainty whether also the introduction of these more simple technologies described in the model would not in fact increase the labour productivity. Data on labour productivity which are comparable over systems and places are hard to get. Through a critical review of the empirical basis for the assumption of diminishing returns to labour, Hunt (2000) shows that arguments both for and against are associated with considerable inaccuracies. In his own analysis of case material from Southeast Asian rice farming systems he concludes clearly against a declining labour productivity associated with intensification.

The assumption of diminishing returns to labour is important because Boserup sees this as the major explanation for why it would take increased population densities to create a stress situation that would trigger the intensification process. People are in Boserup's view interested in obtaining an adequate output per head and thereafter to maximise leisure. Therefore, an inten-

sification which assumes diminishing returns to labour, would not be likely to appear unless a stress factor compels people to do it. However, if the assumption of diminishing returns to labour is no longer valid, that is if the labour productivity can be increased through intensification, then the population related stress factor would no longer be required for autonomous intensification to take place. However, this criticism does not exclude population density (and thereby the major thesis of Boserup) as a possible trigger of autonomous intensification, but rather opens up for several factors *other* than population density that may be at play, and thereby offers an explanation of why intensified agricultural systems can also be found in regions of low population density.

As expansion onto new land is not normally associated with the introduction of new technologies besides animal traction, the diminishing returns to labour are likely to be valid for this process as the new land will most often be of inferior quality. The ox-plough may levitate the burden of soil preparation and sometimes weeding, and through the integration of livestock in the agricultural system it may contribute to the fertilisation of the field, but it may not improve the overall labour productivity as will be discussed in relation to the mixed farming model later.

Fertilisation is another central factor in the intensification process. Typically, the use of different kinds of fertilisers will be related to the frequency of cultivation, labour, capital and land availability. Under low population densities and abundant land cultivated in a long-fallow system, the fallow period will be sufficient to maintain the fertility of the soil. However, with decreasing fallow periods, the application of fertiliser will become necessary as a compensation for the nutrients removed with the harvest of the crops. Animals herded by the pastoralists may provide some manure when grazing the stubble fields, but typically the first fertilisation techniques are rudimentary involving no more than a periodic transport of household waste to the closest fields. In later stages of intensified farming more evolved techniques of manuring and composting will be applied, with eventually the use of green manure and legumes in crop rotation under extreme cases of land scarcity. Inorganic fertilisers may be used as a substitute for labour-intensive manuring techniques on selected crops (Pingali *et al,* 1987:5).

Boserup saw the adoption of new technologies as being compelled by population growth and made feasible by additional labour. The technology or knowledge would often be present but dormant until a certain population density is reached, acting as a stress factor, and a new pattern of resource utilisation begins to assert itself (Boserup, 1965:39, 57). Technological change was therefore seen as arising from endogenous causes (Tiffen *et al.,* 1994:264).
As land productivity is improved by the adoption of yield-enhancing activities, the value of the land will rise, which is likely to change the tenure status from commonly owned to private

property. Therefore, the farmer is given the security necessary for further investments in conservation and other long-term productivity-enhancing improvements.[6]

Boserup could establish the close connection between intensification and length of fallow because she saw a close relationship between the length of fallow and the choice of kinds of tools[7] available to the farming community and hence productivity defined as output/man-hour. For example, the plough would not be an option in a system of forest-fallow as the hoe and stick would do much better among the burned trunks and litter left on the unclean field. Likewise, the plough will replace the hoe under shorter grass-fallow systems as the roots of the grasses become increasingly difficult to remove since they are not affected by the burning of the field (Boserup, 1965:25).

Boserup therefore saw technological development as determined by the frequency of cultivation that, in turn, was determined by population growth.

> *"population growth is here regarded as the independent variable which in its turn is a major factor determining agricultural developments. " (Boserup, 1965:11)*

In other words, the Malthusian thesis where population growth was seen as a dependent variable of agricultural production was being turned upside down. Instead, the explanation for the increase in population should be sought in other factors - medical, biological, political etc. (Boserup, 1965:14).

Boserup deliberately did not make a distinction between unused land or virgin land, and land that was part of a fallow rotational system. Boserup's argument was that it is not possible to make a sharp distinction between cultivated and uncultivated land in "primitive" types of agriculture, as:

> *"..most or all of the land added to the sown area as population increases in a given territory was used already, as fallow land, pasture, hunting ground, or otherwise" (Boserup, 1965:14)*

Therefore, expansion as a process was discarded and replaced by the view that the transformation of the agricultural system in response to population growth should be seen as a continuum of land uses with decreasing fallow intervals:

[6] It should be noted that the link between private ownership and security for long-term investments in land may not be so straightforward inter alia because of the transaction costs involved and the privileges of the ruling classes (Platteau, 1995), but as here I refer to the arguments of Boserup this discussion is only marginally relevant for the present study area.

[7] Not to be mistaken with the *make* of tools which is related to urbanisation and not connected to the system of fallow (Boserup, 1965:27).

> *"The very distinction between fields and uncultivated land is discarded and instead emphasis is placed on the frequency with which the land is cropped. In other words, it is suggested the we consider a continuum of types of land use ranging from the extreme case of truly virgin land, i.e. land which is never cropped, through land cropped at shorter and shorter intervals, to that part of the territory in which a crop is sown as soon as the previous one has been harvested. " (Boserup, 1965:13)*

According to Boserup, the frequency of cultivation gives a better understanding of changes in agricultural systems than the distinction between agricultural expansion and intensification which was put forward by other economists of the period. Hence, Boserup makes a clear statement concerning expansion, contrary to the perception of some later researchers e.g. Bilsborrow and Ogendo (1992:38).

In order to understand this apparently subtle difference in the perception of intensification and expansion, one has to take into consideration the traditional definition of intensification to which Boserup objected:

> *"It covers only the use of additional labour per hectare of cropped area, while the change to a more frequent cropping of a given area is not regarded as a kind of intensification. " (Boserup, 1965:43)*

Hence, traditional economics would be likely to underestimate the agricultural potential in a given area where limited virgin land is available for expansion in the traditional sense, because the scope for additional labour in the cropped area will be limited when not taking into account the more frequent cultivation of the given area.

> *"Many economists have overlooked this possibility of expansion of the sown area, and some governments have failed to take account of the spread of multiple cropping in their statistics of food production, thus underestimating the rate of increase of output. " (Boserup, 1990:120)*

When interpreting intensification as more frequent cultivation, the expectations for raising food production and employment in a region with no or little virgin land available will be much more optimistic (Boserup, 1965:44).

Boserup's argument for not distinguishing between intensification and expansion makes sense in a system of e.g. shifting cultivation where the same fields are not necessarily used when cultivation shifts from plot to plot. However, in many agricultural systems the farmer has specific rights to a fallow field and will use the same field again when the fallow period is over. The fallow field must therefore be regarded as part of a permanent system which makes re-opening of a fallow field different from expansion understood as the opening of virgin or previously uncultivated land. Grigg (1979:73) points out that historically, agricultural expan-

sion onto unused land has been an important characteristic of European development and that it is therefore misleading only to see it as a more frequent cultivation of already used land.

It is probably often true that all land is used to some degree but it is one of the major arguments of the present study that this does not necessarily mean that the distinction between expansion and intensification should be discarded. As will be discussed later, this distinction is important in cases where uncultivated land is used for activities that are not part of the agricultural system, or where tenure arrangements are critical for the functioning of this system. In the cases presented in this study the land where agricultural expansion is taking place is used by pastoralists for grazing their herds. Not only does a transformation of these grazing areas to fields lead to the forced migration of the pastoralists and their herds, but it also has serious implications for local farming systems as exchanges of services and goods between farmers and pastoralists are important for the feasibility of the mixed farming system. If expansion and fallow cultivation are not kept separate, it may be overlooked that intensification and expansion are processes that have diverse features. This is the essence of the expansion paradox, and it will be further discussed in a subsequent section (see page 34).

16 years later Boserup was less optimistic with regard to the possibilities of intensification. She writes:

> *"...population density has adapted to the natural conditions for food production by migrations and difference in natural rates of population growth... " (Boserup, 1981:15)*

alongside the old theme of the production system adapting to the population density. This can be seen as a partial acceptance of the Malthusian perception, as population density then becomes a dependent variable of the natural conditions. The 1981 study is, however, based on aggregate statistics, and the conclusions derived from them are, therefore, of a more general character. The apparently poor performance of intensification is being explained using some new conditions and the reappraisal of some old ones. In this study, urbanisation is not merely seen as a precondition for the division of labour and hence the development of better makes of tools, but also as a constraining factor, as several post-colonial governments pursued policies that favoured urban-based industrialisation. This resulted in poorly-developed infrastructure in rural areas, which hindered the widespread use of modern inputs, which form part of the intensification process. It also undermined the population density needed in the rural areas for intensification to take place, as young people had been influenced by new means of communication resulting in a strong pull effect towards the cities (Boserup, 1981:203, 205, 211).

Boserup was later criticised for having overestimated the positive role of intensification in curbing the degradation of the environment following more frequent cultivation and expansion. It was said that:

> *"Slowly rising population densities may have once been enough in themselves to bring about positive changes associated with technological adaptation in production, resource conservation, and consumption behaviour, but arguably this is no longer the case in Africa; the transition to high density populations has been too rapid. There has been little technological change in agriculture. The traditional farming systems of bush-fallow were meant for low levels of population, not rapidly rising densities. " (Lele and Stone, 1989:20)*

and:

> *The natural process of intensification is far too slow in relation to the rate of mining, given the rapid growth of population. " (Ibid.:10)*

This was supposed to be especially true for the very high rates of population growth found in Africa, and it explained partially why intensification apparently had not been a significant development trend. Especially the limited state and policy considerations were being emphasised as a serious shortcoming of the Boserup hypothesis (Lele and Stone, 1989:5, 9-10).
A similar statement can be found in a later World Bank publication, though with more emphasis on the role of women and the positive feedback from a missing economic and agricultural development on fertility rates and hence population growth (Cleaver and Schreiber, 1994).
However, it must also be noted that the rhetoric and argumentation used in these World Bank papers correspond pretty well to what has been heavily criticised lately, especially by British researchers.[8] The conclusions based on aggregate official FAO and government data, extrapolation of past and current trends and rates, and a very pessimistic more or less preconceived view on erosion and degradation all add up to an alarming future scenario. Whether this may be true is not within the scope of the present study to decide; yet a discussion of the possible implications of this new critique of the doomsday narratives is touched upon in a subsequent section (page 72).

Intensification in itself implies increased levels of inputs in order to gain a higher output. Higher levels of input can be translated into higher investments that the farmer has to undertake. Berry (1993:181-183) shows how several studies have indicated that the increased productivity associated with intensification requires further investments in capital and labour. As labour, according to these studies, is one of the principal constraints on expanding agricultural output, sustained agricultural growth requires mechanisation that demands access to capital. Capital and credit are often seriously limiting factors in rural Africa, which is why

[8] See e.g. (Leach and Mearns, 1996b; Scoones, 1994b; Behnke *et al,* 1993; Fairhead and Leach, 1996; Binns, 1995)

intensification is often not a viable path for the local fanner. Instead, Berry focuses on access to resources and to the associated

> *"..changes in the organization of the agricultural production and specific regional configurations of economic, political, and social change. " (Berry, 1993:183)*

Access to resources and tenure arrangements are increasingly becoming critical factors for agricultural intensification potential. Traditional tenure arrangements have normally offered adequate security in the form of cultivation rights based on inheritance, kinship, and occupancy for the individual farmer to make investments in the land. However, with the growing demand for land stemming from population growth and immigration, local tenure rules have come under pressure and may no longer be sufficient. The various sorts of user rights that may coexist on one field, i.e. the cultivation rights of the farmer during the growing season; the grazing rights of the herder after the harvest, including rights to crop residue; and specific rights concerning the utilisation of trees on the field, can initiate conflicts when e.g. the farmer wants to use the crop residue for his own animals or for construction or burning. Newcomers may become so numerous that they can exert pressure on the local tenure systems and influence the tenure rules so that they resemble more the system from to which they are accustomed (Cleaver and Schreiber, 1994:8-9, 56-57). Furthermore, traditional tenure has in several cases, among them Burkina Faso, been targeted in connection with political movements and shifts. In Burkina Faso, the whole traditional tenure system was abolished in 1983 and a new politically controlled village representative was introduced who today still has some influence in many villages. The traditional village chief and the political representative now coexist in most villages. It is, however, not rare to find that the political representative, who unlike the village chief is elected by the villagers, is in fact today the son of the village chief. This issue will be further dealt with in the description of the study area (page 115).

Boserup's model of agricultural intensification describes agricultural development as a continuum of different stages each characterised by a particular farming system. It is a stage model combined with a farming systems approach. Such a stage model has been criticised for being a static and deterministic classification, indicating a certain development process with distinct phases through which the agricultural systems passes, ending up with the technologically advanced and intensive specialised farming system. This may lead to a perception of the early stages e.g. shifting cultivation, as a backward technology which may further influence policy formulation against these "primitive" practices (Richards, 1983:53).
It is, however, noted in the work of Boserup that the agricultural system is primarily determined by a number of contextual variables among which population density is seen as especially important, and that the systems may revert to less advanced technologies or stages if population density falls dramatically, making arable land abundant, a process termed extensi-

fication (Boserup, 1965:62; Netting, 1993:265). Furthermore it is specifically mentioned that several stages of agricultural systems may coexist in the same village (Boserup, 1965:59). The Boserup model, therefore, though being a stage model, is not confined to a deterministic development path, but allows for alternatives without losing its explanatory force.

In concluding this introduction to agricultural intensification it is perhaps appropriate to draw attention to the notion that it is dubious whether agricultural intensification can actually be seen as progress. Intensification is, according to Boserup, driven by the diminishing returns to labour meaning that a farmer will have to work harder to gain the same output. This is done through the introduction and refinement of labour-saving techniques often in the form of some sort of mechanisation. This, however, is similar to a process termed agricultural involution which is not seen as progress, but rather as a deteriorating agricultural system, actually obstructing the way to large-scale production as it sustains labour input at returns that are below market wages (Geertz, 1963:81; Netting, 1993:287). Geertz described for Java how the wet rice system had an enormous potential for absorbing a growing population by increasing area productivity through ever more refined techniques but at the cost of falling labour productivity. This process happened as:

> *"tenure systems grew more intricate; tenancy relationships more complicated; cooperative labor arrangements more complex - all in an effort to provide everyone with some niche, however small, in the overall system" (Geertz, 1963:82).*

It is a sort of "technical hairsplitting" where the system does not develop *"into a new pattern but rather continues to develop by becoming internally more complicated" (Ibid.:81).* Hence the rural population thus being absorbed in the rural economy at below market wages because of falling labour productivity, hindered the development of non-farm activities like industrialisation and the further reinvigoration of the peasant sector through the provision of cheap fertiliser, more effective tools, education etc. (Geertz, 1963:135). Whether Geertz's more general predictions for Javanese society are valid after e.g. the "green revolution" is dubious (Netting, 1993:287) but the most interesting point in relation to the present study is that the same process can be seen both as a positive development far removed from Malthusianism, and as a degradational path more in the line with the predictions of Malthus. However difficult it may be to solve this contradiction in general terms, a return to the preconditions for the processes in West Africa and Java, respectively, including the cultural, historical, social and ecological characteristics, will probably lead the way for an understanding of the differences. This, however, is beyond the scope of the present study, but it is worthwhile remembering that intensification (and involution) is essentially a question of *"running faster to stay in one place"* (Netting, 1993:286) and one might wonder whether this should be regarded as a positive development.

1. Intensification and expansion, conceptual discrepancies?

It is estimated that about 80 percent of the growth in African agriculture originates from the expansion of land under cultivation (Kates *et al,* 1993:7). When faced with increased demand for agricultural production during population growth the first reaction of the farming community will probably not be to invest in new technology, soil fertility improvements or shift to cash crops. Rather, they will begin by gradually spreading their cultivation unto unused land, probably in a forest-fallow system (Boserup, 1965:58; Cleaver and Schreiber, 1994:44; Grigg, 1979:73).

Expansion and intensification both signify agricultural development, though somewhat different stages in the process. When land is abundant it is less likely that intensification will take place (Bilsborrow, 1987:189), as expansion may be seen as forerunner for intensification. In the words of Lele and Stone (1989:14):

> *"..the area frontier[9] acts more or less like an hourglass by which to gauge the time remaining for autonomous intensification. " (footnote added)*

A certain threshold for the profitability of clearing new land will determine whether alternatives are considered. This, of course, will vary according to locality, as it depends on the "resistance" of the land i.e. the vegetation that must be cleared, the soil conditions, the previous use, if any, the usufruct rights, the distance etc.

Technological innovation and adoption are important factors in this process where e.g. the ox-drawn plough may stimulate both processes.[10] Whether or not expansion will eventually be succeeded by intensification will depend on a specific set of local preconditions.[11]

When the population density increases further the farmer will cultivate the land he already uses more frequently. The more frequent cultivation of fallow land can be defined as the beginning of intensification itself as discussed in previous sections, but agricultural expansion is a common process that is separate from intensification and may even counteract intensification through the expansion paradox.

Table 1, below, presents a simplified summary of the consequences of expansion and intensification. The comparison illustrates the potential significant differences between intensification and expansion from a Boserupian inspired point of view and may not be valid in all cases,

[9] That is the division between unused cultivable land and cultivated land.
[10] The mechanisation process will be further dealt with in a subsequent section (page 54)
[11] The preconditions for intensification will also be discussed in a subsequent section (page 43)

as the local context has to be taken into consideration. Each relationship will be elaborated upon below.

	Output/work-hour	Output/area	Input/area	Work-hour/cap.	Envir. Degrad.
Expansion	Down	Down	Down/Nil	Up	Up
Intensification	Down	Up	Up	Up	Down

Table 1 Simplified consequences of intensification and expansion. See textfor elaboration.

Both processes will result in a fall in **output/work-hour** because of diminishing returns to labour and an increased workload for the farmer. Mechanisation in association with intensification may raise the output/work-hour through labour-saving technology like the plough, but when the work used for animal maintenance is included, this effect may be somewhat or wholly counteracted (see also Animal traction, page 54). As discussed previously, however, diminishing returns to labour in relation to intensification is still debated and far from commonly accepted. If, in fact, the diminishing returns to labour thesis is rejected, as maintained by Hunt (2000:271), the difference between intensification and expansion will be even more explicit, but the labour productivity may still be conducive for triggering the intensification process as it then will act as an incentive instead of only the population density acting as a stressor.

When the **output/area** increases with intensification due to technical and agro-ecological improvements, it is likely to decrease under expansion because of declining soil-fertility on old fields and the inclusion of new fields, often of inferior quality. New fields may raise the yields initially as the fertility of unused land may be assumed to be better than that of old fields. However, it stands to reason that the land cultivated last is also the least suitable, hence such an eventual initial output increase may be expected to be a short-lived phenomenon. This of course will be rather locality specific.

The **input/area** may, under expansion, be expected to remain unchanged or to fall as the farmer may have difficulties applying the same amount of labour to new fields as well as to the old. This may further exacerbate a decrease in the output/area described above. Inputs like fertilizer etc. are normally not associated with expansion. For intensification, input/area is part of the definition.

For both intensification and expansion, the **workload/person** is expected to increase. In the case of expansion, this is because the area cultivated is increasing while the number of household members is assumed to be constant; and in the case of intensification increased labour input is often intrinsic to intensification, again assuming that household members are constant. Expansion and the more frequent cultivation of fallow land unaccompanied by anti-erosion measures make **soil degradation** and ultimately loss of soilfertility more likely. Expansion by itself does not ensure compensation for the nutrients removed with the harvest or protection against cultivation-induced erosion (Lele and Stone, 1989:14, 19; Cleaver and Schreiber,

1994:48). Furthermore, expansion is often associated with deforestation which is seen by some as degradation in itself but which may also aggravate soil erosion through decreased vegetation cover. Technological innovation following intensification is likely to comprise anti-erosion and fertility maintenance measures, which is why intensification have been seen to have positive environmental effects.[12] This, of course, will depend much on the local context, but as investments associated with intensification are assumed to be of a long-term character as the farmer is not expected to intensify his/her production if (s)he does not plan to keep the land for the foreseeable future, it is also likely that this will include taking care of the land as it is the most important capital asset.[13]

2. The expansion paradox

The previous sections described how and why Boserup discarded expansion as a process distinct from intensification. However, the inclusion of expansion in the intensification hypothesis has some problematic consequences.

Boserup's development model goes through several phases in a somewhat deterministic way ending up in highly intensified production systems. Yet expansion may not necessarily be a process that leads to intensification. Expansion and intensification may point in quite different directions if the preconditions for intensification are not present. If the agricultural potential is too marginal to justify further investments by the farmer, or other common preconditions for profitable agriculture are not met, expansion may be the dominant development as long as new arable land is available. In such marginal regions intensification may not be a feasible option when expansion onto new land is no longer possible.

This points to another problem of seeing expansion as an integral part of intensification. As mentioned before, Boserup discards expansion as she sees all land as being used to some degree, and to develop this land into cultivation is therefore merely a change in the intensity of usage. Boserup notes that:

> *"One of the advantages of the concept of frequency of cropping, as suggested in the present study, is that it makes it possible to bring fallow land, pastures and animal husbandry within the purview of the analysis and thus to appreciate the close relationship between the changes in technical and economic factors on the one hand and changes in land tenure on the other." (Boserup, 1965:14)*

[12] A prime example is the Machakos area in Kenya described in Tiffen et al. (1994)

[13] Of course, exceptions where farmers make investments motivated by short-term profit can be found. An example could be rice fields in Thailand being converted to short-lived but highly profitable shrimp ponds that over a short period render the fields unusable for future cultivation because of salinisation.

This is probably also true in most cases, or seen from an aggregate point of view, but it overlooks the possibility that non-cultivated land may be used by others than the ones who are seizing it for cultivation, and that alternative uses of the land may have been sacrificed in the expansion process. One such activity could be marginal land used for grazing by pastoralists. Taking their grazing rights away for the benefit of cultivation may then mean intensification in one system, but may also mean limitations or even total abandonment in another system.

Often economic activities are performed by specialists based on separate socio-cultural or ethnic groups who have developed a system of exchange of products and services provided by the specialised groups. An example of such a system can be found in the present study area where the ethnic group Bisa primarily are farmers, while the animal husbandry is in the hands of the Fulani pastoralists. Products like grain, milk, and manure and services like herding of farmers' animals, treating of disease in animals, and ploughing of fields are exchanged between the two groups.

When discarding expansion as a distinct process there is a risk of overlooking that there may be several coexisting land use systems relying on the same natural resources but based on separate socio-cultural and economic groups with different agendas. These systems may share complementary relations as in the example above, and if one group is displaced by agricultural expansion these complementary relations are likely to disappear. If the complementary relations support the feasibility of the further intensification, the expansion paradox may evolve, whereby agricultural expansion, instead of acting as a forerunner for intensification, may actually work against the intensification process. It is a paradox, because expansion traditionally is seen as an integrated part of the intensification process as described previously. As will be discussed later, the area studied here supports the existence of the expansion paradox, as agricultural expansion has consequences for further intensification through mixed farming because exchange relations between farmers and pastoralists are an important factor for the feasibility of introducing ox-mechanisation into the farming systems.

A result of the foregoing discussion is that the present study will operate with a clear distinction between expansion and intensification. This should also be seen in recognition of the conditions that exist in the study area, where fallow is not used much and the prevalent development trend is the expansion of cultivation unto uncultivated land that also functions as essential pasture for the pastoral Fulani. Though Boserup is right that uncultivated land has alternative uses, it would be misleading to gather these uses under one and the same system and hence, primarily, a single ethnic group.

That pastoralists, or others who have the grazing rights to fallow land or other resources, may become marginalized in the process of intensification is also duly noted by Boserup:

> *"Under land use systems based on the grazing of fallow land, some of the cultivators, or some non-cultivating members of the village community, enjoy the right to graze animals on the fallow area for a certain part of the year. In that case, the substitution of a more intensive system for the old one requires the abolition of the grazing rights. " (Boserup, 1990:104)*

Boserup anticipates that land tenure have to change according to land use. This must be seen as a natural consequence of development, but it may also have adverse effects and lead to open conflicts when a specific ethnic or other group is dependent on this land tenure.
Conflicts between farmers and herders over access to land and other resources, or crop damages due to stray animals are a common phenomenon in the study area and elsewhere in Africa where these two groups co-exist (Breusers and Nederlof, 1998; Bassett, 1994b; de Haan, 1998; Faho, 1995; Delgado, 1979a: 154; Faure, 1990:348).

In a competitive environment the most powerful actors are most likely to prevail. In this process there is nothing to ensure that the dominating agricultural system will be the most environmentally and economically sound utilisation of natural resources or even that it will lead to agricultural intensification.

3. *Market and policy-induced incentives for agricultural intensification*

Other factors than population growth may influence the intensification process. The idea behind intensification is to produce more food. More food is required because of an increasing population according to the Boserupian version. However, the need for higher agricultural output may also come from other sources than pure population growth. Market conditions and state policies are among the most important factors that can drive intensification, either through stimulation of or irrespective of the population density.

Food or other agricultural products can be converted into money. As long as there is a market, they are tradable goods. Thus, if the farmer is interested in products that he cannot produce himself, he has the option of exchanging some of his agricultural produce on the market for that desired good. What determines his desire for a certain good, however, is not just a question of population density. Factors like cultural and personal preferences, status, advertising etc. all have a role to play in determining the farmer's consumption of non-agricultural goods. Advertising is becoming an increasingly important factor in rural Africa, as radio, television, and better infrastructure creates a demand for things which the farmer may not even have been aware of before.[14] As a result the fanner's need for cash will increase, hence he will have to increase his agricultural production under the assumption that alternative sources of income

[14] See also the discussion on possible changing values among the young Fulani (page 171)

are not available for him. This is one motive for the intensification of agricultural production independently of population growth.

However, to assume that alternative sources of income are not available to farmers is hardly realistic. Off-farm income is very important in many West African households. This may be earned through seasonal wage-labour in the cities, market transactions, handicrafts or other local services, and remittances from migrant family members. Off-farm income in the Sahelian and Guinean zones of Burkina Faso has been shown to account for more than half of the total household income, including the value of the subsistence crops, while in the Soudanian zone the figure was around 26% (Reardon *et al,* 1992:280; Reardon *et al,* 1988:1073; Savadogo *et al,* 1994:609). In the Sahel this high degree of diversification of economic activities is primarily motivated by risk aversion as a response to the dramatic climatic and environmental variations, while in the Guinean zone it is heavily motivated by a need for capital to be invested in cash-cropping because of a lack of credit opportunities (Reardon *et al,* 1992:283, 292). Though not clearly stated in the references, the Soudanian zone must be assumed to be situated in-between these extremes, i.e. there is less need for risk-aversion compared to the Sahel because of a more stable climate, and at the same time a lower agricultural potential compared to the Guinean zone which does not encourage such capital investments, so the off-farm share of the household is lower. It is also noted that off-farm activities may hinder investments in agriculture and hence intensification as this would have significant opportunity costs in relation to other risk-aversion (Reardon *et al,* 1988:1073) or more profitable activities.
In a follow-up study to the Machakos study in Kenya (Tiffen *et al,* 1994), it was also found that especially in the later stages of the intensification, characterised by further investments in in-organic fertilizers and a shift to more capital demanding cash-crops, the access to urban based income is a critical factor (Murton, 1999:44).

Thus, off-farm income may in situations of meagre agricultural potential be more lucrative for the farmer than agricultural intensification. It may also be one of the preconditions for intensification as it may be the only way a farmer can finance the required capital investments associated especially with the later stages of intensification. Off-farm income is hence important to consider when seeking explanations for the apparent lack of intensification, and also helps show how expansion should not necessarily be seen as the forerunner of and an integral part of intensification. This supports the call for operating with a clear distinction between expansion and intensification.

The market or economic incentive is mentioned several times by Boserup in her 1965 work, but only in association with population growth and urbanisation. An economic incentive is seen as a precondition for intensification, and the economic rationality of the peasant is recognised, but the focus is still on population growth as the major determinant (Boserup, 1965: 28,

67). Urbanisation is an important factor as it is seen as a precondition for the division of labour that, in turn, is a precondition for the development, make, and perfection of tools that help offset the diminishing returns to labour (Ibid.:27, 76). However, the notion that the need for a certain cash crop may lead to rapid intensification, whether or not directly supported by government agencies, is not given much attention by Boserup.

An example of such a situation is the increase in wheat production in Nigeria following the 1986 ban on foodstuff imports which resulted in an eightfold increase in the price of wheat. The expansion of areas of irrigated wheat with heavy application of fertiliser had adverse environmental consequences, but it does provide an example of policy and price-induced intensification even in areas where wheat cultivation was not ecologically suitable (Main, 1995:52).

Policy is another important factor that is not given much attention by Boserup. Policy initiatives aimed at introducing elements of intensification in a given area are found in the debate, but most often as examples of failures because they have not been compatible with the local population density and motivation for intensification. The argument goes that the different measures introduced will themselves emerge when the context is favourable in a sort of autonomous process. However, as also emphasised by Lele and Stone (1989), policy may have been underestimated in the Boserup model. The logic of the Boserup argument against policy is compelling and may give plausible explanations to many project failures in rural Africa. But if one accepts that the market also has an important role to play in the intensification process, policy may become an important instrument in regulating or stimulating this market, or indeed even creating it. If, for instance, a government has a policy of promoting a certain cash crop, it could create a market for this crop by offering attractive prices, infrastructure, and perhaps provide favourable credit schemes and production equipment and input packages. Another example is contract farming, where an agency or a private company provides the input and buys the output at a guaranteed price. There are many examples of such initiatives failing, but this does not change the theoretical possibility of such policies actually leading to intensification without an initial population growth, or themselves creating population growth and settlements in new areas.

Later works tend to give more recognition to alternative or supplementary explanations for intensification. Pingali, Bigot, and Binswanger (1987:44) have produced a list of factors that may influence the population concentration in a given area:

- Natural growth of population (caused by high fertility rates, better health care and little migration)
- Soil fertility (causes immigration of people from less well-endowed regions)
- Transport facilities (causes immigration to exploit reduced transport costs)
- Urban demand (causes immigration to exploit market opportunities)
- Health (causes immigration of people from e.g. malaria- or tsetse-infested regions)

- Historic (causes immigration due to flight from tribal wars, slave-raids etc.)
- Land laws, right (causes restrictions on migration and agricultural expansion)

Some of these factors may not only contribute to the growing density of the local population, but may in themselves encourage intensification without an accompanying population growth.

Improved transport facilities have the immediate effect of reducing transport costs, giving better access to urban or other markets. Besides augmenting immigration and population growth, this factor also encourages intensification and expansion as the profitability of the farming increases. Railway is one example of an improvement in transport that has led to intensification and expansion, illustrated by several cases in Pingali et al. (1987:47-48). It should be noted, though, that without the agricultural potential, appropriate soil conditions and climate, the improved transport will not have any of these effects (Ibid.:48).
Urban demand works in a similar way to improved transport facilities, as it provides a market and better prices, thus increasing the marginal returns to labour.

However, in a rural African context it may be difficult to distinguish between population pressure and market incentives as driving forces behind intensification, as the farmer normally produces both for subsistence and the market, and often in a very responsive and flexible fanning system, combining an array of technologies each appropriate for the exploitation of a specific environmental and socio-economic setting. The proportion of cultivation for subsistence and for the market may also fluctuate as a function of state policies.

Increased contact with the markets will provide the information, incentives, and means for farmers to invest in their farms (Mortimore and Tiffen, 1995a:44). Increased market integration will translate into higher prices for the crops cultivated and a subsequent higher return to labour, leading to larger areas being cultivated (Pingali 1987 cited in Mortimore, 1993b: 17). In addition, the need for income in the household will increase when more basic goods are acquired through the market. Eventually, higher value crops may substitute lower value crops and the market income is invested in more efficient equipment, leading to an amplification of the effect of population pressure on the intensification process (Ibid.: 17).

Therefore, several factors other than the population growth may encourage intensification, and the path to intensification is not as clear as the theory might suggest. Different motivations and resource endowments may lead to divergent processes, hence it is important to keep an open mind regarding the array of possible variables other than population growth, and also to uphold a distinction between expansion and intensification.

4. New life in the intensification paradigm?

Boserup's thesis was largely based on empirical findings, and new empirical studies have revitalised her findings by confirming the ability of the local population to improve on their situation through counter-erosive measures and increased market integration (Tiffen *et al,* 1994; Meertens *et al,* 1996; Kates *et al,* 1993).

An interesting example of a positive intensification process is presented by Tiffen, Mortimore and Gichuki (1994) from the Machakos district in Kenya. Here, high population growth recorded since 1930 has led to a remarkable agricultural growth and investments in conservation. The systems have been so successful that agricultural production has been able to keep up with population growth, and has done so through ecologically sustainable practices.
One of the most important measures applied has been the terracing of sloping fields. In some places all arable land has been terraced. Other factors include the introduction of improved maize varieties back in the 1960s, and ox-ploughs introduced in 1910 and adopted by 62% of the farmers by the 1980's. Altogether, 35 field and horticultural crops, 5 tillage technologies and 6 methods of soil fertility management were adopted by the Machakos people (Mortimore and Tiffen, 1995b:76). The introduction of ox-ploughs led to an increase in the cultivated area, shifting cultivation came to an end, and row planting together with better weeding replaced broad-casting seed (Ibid.:81). Livestock are for the most part kept in stalls or pens and fed with cut grass, residue, and fodder grass cultivated on terrace banks. Manure is collected in the pens and transported to the terraced fields. Though livestock numbers have not kept up with the remarkable agricultural growth, the integration of crop and livestock production played a crucial role in ensuring the efficiency of the nutrient cycling system (Ibid.:87). Total livestock production has increased, but the number of cattle per person has declined considerably. Where as before, cattle were primarily held for investment or savings purposes, they gradually gained additional importance as suppliers of manure and draft power (Tiffen *et al,* 1994:89).

Though the Machakos case provided the empirical background for a much-needed new optimism, this "success story" has been criticised for not revealing the whole picture. The choice of time frame beginning from 1930 has been accused of ignoring the forced displacement by the colonial administration that led to the crowding in Machakos and restricted their possibilities for migration. This curtailment may have had a greater effect on intensification than population density as such, in that such density under normal circumstances may have led to migration instead of intensification (Rocheleau, 1995:3). In replying to this critique, Tiffen and Mortimore consider population density as given, hence the colonial past that led to the population density is less important (Tiffen and Mortimore, 1995:5). However, if the possibility for migration is seriously curtailed by exogenous forces, then this must be seen as another locally-specific precondition for intensification that may limit its universal validity.

The Machakos district is no longer isolated, and one of the important preconditions for intensification is interaction with the Nairobi market. The demographic causality is therefore questioned as the innovations and technical change may be caused by other factors (Juma and Field-Juma, 1995:3).

Also, the scale chosen and the delimitation of the study area may influence the result. It is argued that, in fact, a high rate of migration from the area to new dry frontiers (semi-arid lands with little or no agricultural activity) is taking place like it did in Machakos prior to 1930. Now Machakos has become a sending area instead of a reception area, sending its spill over into a new dry frontier where expansion continues[15] (Rocheleau, 1995:4). Thus, the capacity of labour-absorption in the intensification process may be overestimated if this migration leads to expansion outside the chosen study area.
In addition, migration to marginal areas (slopes, degraded, less desirable, and cheaper) by the poor fraction of the population within the study area may be overlooked by the use of location-level aggregate data (Rocheleau, 1995:4). For the people who did not have the means to intensify their production, this semi-latent expansion is a last resort.

This raises the important question of the socio-economic consequences of intensification in Machakos. The use of aggregate income data in the Machakos study does not reveal social differentiation among the individual households. In a follow-up study to the 1969 study by Frederick Owako in the village Ndueni in the Machakos district, Murton (1999:45) shows how this difference of scale may show that:

> *"In the absence of greatly increased capital availability for investment in agricultural productivity, population growth will continue to drive many households in Ndueni along an involutionary spiral of poverty amidst green and terraced fields."*

While almost all farmers were able to adopt the first phases of the intensification that primarily required labour investments (terracing and mulching), only the farmers with access to urban income sources could afford the further investments in chemical fertilisers and the shift to more capital-intensive cash-crops. The better-off farmers have subsequently bought land from the poorer fanners who had not the means to intensify and who faced diminishing yields together with growing families. A socio-economic polarisation, including class formation as the richer farmers employ the poorer ones as wage labourers, has thus taken place in Machakos alongside the agricultural intensification.
It therefore seems that two parallel processes have taken place in Machakos. One of intensification for the rich farmers with access to urban capital, and one of agricultural involution for

[15] *"Farmers may sell 1 hectare in their home place to purchase 10 hectares on the frontier, then cut down 10 hectares of dry forest to make charcoal that finances the establishment of 2 hectares of cropland"* (Rocheleau,

the poorer farmers who also have experienced diminished self-sufficiency, increased dependency on agricultural labour for the rich farmers, and malnutrition (Murton, 1999; Rocheleau, 1995).
The success of Machakos has thus to been seen in a broader socio-economic context and at a larger scale that allows for a more nuanced picture.

Site-specific findings like those from the Machakos study indicating a more positive outcome of population growth are also supported by a more general study. Turner, Hydén and Kates (1993) have shown, through selected case studies especially from Nigeria but also East Africa, that factors that were typically linked to population growth and intensification were surface changes including deforestation, the introduction of new crops and biotechnological inputs like fertilisers and pesticides, increased market integration, diversification into alternative economic activities, especially the migration of young males, and the expansion and overall increase in agricultural production (Hyden *et al,* 1993:403-406). It was furthermore shown that the local population had a larger workload that often became the burden of the women, who were the population group that did not migrate, but stayed behind. Increased social differentiation evident from increasing discrepancies in access to land and other resources, was also part of the intensification process. Concerning environmental degradation, it was shown that except under extreme population densities, especially vulnerable areas, or where organisational or socio-economic factors impede the implementation of conservation activities, the environment could sustain relatively high population densities without decreasing its agricultural potential. Agricultural involution was not apparent until very high population densities were reached. An overall assessment of the effects on the well-being of the population, roughly translated into the availability of food and improvement in general material standards, failed to yield an unambiguous picture (Ibid.:408).

New optimism is therefore arising instead of the general fear of the calamitous consequences of the population growth. However, empirically based examples of a "Malthusian" outcome or the downward spiral ending at a low-level steady state can also be found (Geertz, 1963; Ruthenberg and MacArthur, 1980; Webber, 1996; Lele and Stone, 1989; Cleaver and Schreiber, 1994). Environmental constraints may simply be so strong that they impede agricultural growth, or high levels of input may result in an intensification that is not justified by population density (Kates *et al,* 1993:18). Soil fertility may deteriorate, erosion may become more pronounced if the intensification is not followed by appropriate counter-measures. The farmer may be burdened with extra work, which easily could lead to even more pressure on the women and a worsening of their situation.
Furthermore, competition and conflicts will almost invariably be part of the intensification process, as the usufruct rights to land in Africa are usually rather obscure, and as the value of

1995:4).

the land will increase with increased population growth. Besides, there is little doubt that intensification based on technological innovations and market integration will lead to increased dependence on external factors upon which the fanner has no influence. These could include the prices of input supplies, tools, fodder resources and the prices of the products produced. Thus, serious uncertainties are associated with the intensification process in sub-Saharan Africa, which are rather well expressed in the words of Kates, Hydén, and Turner (1993:21):

> *"Long-term population growth and economic development usually do not take place without intensification and agricultural growth, although intensification and agricultural growth do not inevitably follow population growth and are not necessarily beneficial or sustainable "*

5. Preconditions for intensification

In the original work of Boserup from 1965 it was acknowledged that population growth alone was not sufficient to initiate technological change (Boserup, 1965:41). Other later writers have similar reservations. Netting (1993:275) notes that:

> *"the statistical relationship between population density and intensity is strongest in those cases where environmental constraints on land quality are moderate - that is, where labor, skill, and technology can effectively raise land productivity or carrying capacity"*

and states that there may be a limited range within which such conditions prevail and intensification is therefore possible (Cleveland, 1998:327). In other words, there are some preconditions that must be fulfilled before intensification can take place. Boserup mentions that technological innovations and investments must be economically rational, that a critical population density has to be reached, and that knowledge of improved techniques must be present. In fact, if this knowledge is not present, it may lead to more frequent cultivation followed by declining yields and possible exhaustion of land resources (Boserup, 1965:41, 67-69). However, Boserup does not become more specific as to the quantification of these preconditions or their mutual dependencies and relations.

Newer empirically-based studies have shed more light on these preconditions. For an autonomous intensification process to take place, the area must have some initial potential. Without this development potential in the form of some market infrastructure, some agro-ecological potential of the natural resources and some knowledge or tradition of exploiting this potential, it seems unlikely that population growth would lead to anything but migration. Some of these studies will be considered in the following.

Though the Machakos case (page 40) can be seen as a confirmation of important parts of the Boserup thesis,[16] due attention must be given to the preconditions on which development rests. Especially when the results from Machakos are seen in a West African perspective and the question is raised as to whether a similar development path may be expected here.

The Machakos district is relatively advantageously located only 50 km from the capital Nairobi that provides for good market access. Cash crops like coffee dominate, and fruits are sold to the canning industry. It is possible here to talk of *"opportunities provided by the market"* (Mortimore and Tiffen, 1995b:77).
The agro-climatic range from sub-humid to arid environments within the same district, implies that high-potential areas are present that may function as catalysts for general agricultural growth and provide an important basis for diversification. With two rainy seasons it is possible to have two annual crops, an advantage not present in semi-arid West Africa, and altitude and moderate temperatures in some areas limit evaporation and increase the efficiency of the bimodal rainfall regime (Tiffen *et al*, 1994:275).
Population densities are relatively high with more than 400 persons/km^2 in some areas, and importantly and rather unusually in an African context, land titles have been secured, based on local customs already established in the 1930's and registered since 1968.
On the other hand, circumstances that Machakos has in common with other African semi-arid regions are *"...low and variable rainfall, low average soil fertility, increasing population densities, and rapid socio-economic change... "* (Ibid.:276).
Many factors have therefore had an influence on the positive development of Machakos that may not be found in more "normal" semi-arid environments.

Hydén, Kates, and Turner (1993) have tried to define the conditions under which population growth leads to agricultural growth through intensification.
On the basis of their case studies, discussed previously (page 42), they identified a set of conditions that could be associated with a successful outcome of the intensification process:

- Favoured environments basically understood as good soils and stable rainfall that provide least resistance to production or alteration for production.
- Promising location, meaning good market access, infrastructure, and accessibility to capital inputs.
- Regions of refuge, i.e. that a population feels secure in the location or cultural affiliation.

[16] However, Tiffen et al. places more emphasis on external markets and inflows of new ideas from external sources (Tiffen *et al*, 1994:267).

- Supportive socio-economic organisation and structures, with the most important aspects being flexible tenure rules and arrangements, government policy and functioning markets. (Hyden *et al.*, 1993:410-13)

It should be noted that the cases upon which the above conclusions have been drawn, all had relatively high population densities, around or above 200 persons/km^2, which renders direct comparison with the present study area difficult, since the population density is around 55 persons/ km^2. However, the findings of Hydén et al. do pretty well confirm the findings of Tiffen, Mortimore and Gichuki (1994) from the Machakos, suggesting that some important preconditions have to be present in order for a successful autonomous intensification process to take place.

6. *Summary*

The agricultural intensification model as defined by Boserup stands in contrast to the Malthusian linkage of population growth with environmental degradation. Agricultural development through intensification is seen as a variable dependent on population density, and later studies have shown how increased population density may lead to a sustainable exploitation of the natural resources.

Agricultural intensification, however, is not an unambiguous process. It may be initiated by factors other than population density, and empirical studies suggest that the process is dependent on a number of preconditions that must be fulfilled. In case these preconditions are not present, agricultural expansion, seen as an integral part and forerunner of intensification by Boserup, may not lead to this process. This may have negative consequences for the development potential of a region and may be especially problematic if several agricultural systems based in distinct cultural and socio-economic groups are dependent on the same resources. Therefore, intensification and expansion should not be seen as part of the same process, but must be treated as separate, as otherwise it may be overlooked that a specific activity or ethnic group may be marginalized without the ensuing agricultural intensification necessarily developing. If further intensification is partly dependent on complementary links between these groups the expansion paradox may evolve where expansion is in reality working against intensification.

Agricultural intensification often manifests itself through a mixed farming model where agriculture and animal husbandry increasingly become integrated. In the following, the implications of this will be discussed as it has direct relevance for the present study area.

C. The mixed farming discussion

In the present study the focus is on animal husbandry, especially that of the local pastoralists, the Fulani. So far, the major part of the discussion has been concerned with the development of the crop-farming systems. This, however, follows from the close relationship between animal husbandry and the crop farming systems. As will be discussed in a later section, this relationship takes a specific form as the entrustment system in the study area. One of the major reasons for this close relationship is the need for animals as draft power and manure supply that emerges when the fanner is forced to adopt labour-saving technologies as part of the autonomous intensification process. The crop farming system thereby evolves into a mixed fanning system.

> *"Mixed farming, combining crop and livestock activities, holds considerable promise for meeting criteria of environmental sustainability and of improved productivity. Farm animals are an important link for recycling resources within the farming system, and draft animals represent a major step towards agricultural intensification and, through the provision of transport services, market orientation. Indeed, the largely un-utilized potential for using animal traction in both farm operations and transport needs to be realized. " (Cleaver andSchreiber, 1994:137)*

This description is quite representative of the general view of the qualities of the mixed farming model. Mixed farming is a general term covering many forms of integration of animal husbandry and crop farming. It is not a fixed system that may or may not be adopted by the farmer or the pastoralist, but rather a way of utilising the resources available that will often emerge through the autonomous evolution of the farming system. Mixed farming has been viewed as the most promising means to increase the agricultural productivity of semi-arid West Africa (Turner, 1993:436) as animals would provide the traction power and the manure associated with the agricultural intensification. With the high population growth in many semi-arid areas the primary justification of the mixed farming model has recently shifted from the supply of draught power to the benefits of manuring (Ibid.:438). The following section will first examine how the intensification process as treated previously may be expected to influence or to evolve into a mixed farming system, after which more specific issues of relevance for the present study will be considered.

Mixed farming systems are inherent to the agricultural intensification process as these systems are evolving as a function of population density, scarcity of land, the need for animal traction, and the increased need for nutrient transfers to fields under shorter fallow periods and eventually permanent cultivation. Thus a typology of mixed farming systems will to a large extent coincide with typology of the intensification process.

Powell and Williams (1993:22-23) describe the mixed farming system as a process consisting of 4 phases:

1. Pre-intensification phase where crop production and livestock husbandry are operationally separate entities;
2. Intensification phase where crop and livestock production integrate mostly through animal draft power and manure linkages;
3. Income diversification phase when investments are made to improve forage supply and quantity;
4. A return to specialisation through commercialisation.

The stages basically describe the transition from interaction between farming and animal husbandry towards integration. Before going into more depth concerning the complexities of each stage it must be pointed out that interaction and integration are distinct terms. Interaction implies that animal husbandry and crop farming are separate systems where animal husbandry is principally the activity of specialised groups like the pastoral Fulani, and farming is dominated by farmer specialists like the Bisa in the study area. Interactions take place in the form of exchange of manure and feed, i.e. through manure contracts, and entrustment arrangements may allow the farmer to own animals without having to allocate labour to herding. Integration of animal husbandry and farming appears when the farmer starts keeping animals himself for traction, manure or other purposes, and feeds the animals with his crop residue or cuts and cultivates fodder grasses (Speirs and Olsen, 1992:8; Harris, 1996:14). In an integrated mixed farming system the pastoralist also cultivates crops in order to meet the cereal needs of the household. The distinction between interaction and integration is, of course, fluent and various intermediary states may co-exist in an area or a village.

As mentioned, the transformation from interaction to integration of farming and animal husbandry is closely related to the intensification process. At low population densities it will be cheaper to specialise in animal husbandry[17] as fallow makes manuring and the need for animal traction superfluous. Extensive agriculture creates few interactions, and those that occur mainly take place through markets or contracts among specialised groups (Mclntire *et al*, 1992:24). This stage of the mixed fanning, roughly corresponding to Powell and Williams' 1st stage, is principally found in arid environments where the potential for crop farming is low (Powell and Williams, 1993:24). It should be mentioned however, that exogenous events like the drought at the beginning of the 1980's has led to significant changes in the former pure pastoralism in the Sahelian towards mixed fanning. This may partly be ascribed to the diffi-

[17] That is, not to be involved in crop farming at all, but to satisfy the need for cereals through exchange with farmers.

cult situation of the pastoralists after the drought when their herds were seriously reduced, forcing them to adopt crop-farming as an alternative but necessary strategy (Toulmin, 1993).

When population density increases, the competition for land and its value increases. In addition, the need for manure and animal traction will increase. At the same time, the expansion of agricultural land will provide more crop residue usable as fodder and the costs of livestock integration will therefore be lowered, thus reinforcing integration (Mclntire *et al,* 1992:36). The former pastoralist will become part of the integration process as the land available for grazing decreases and he therefore becomes increasingly dependent on access to crop residue for fodder which will give him the incentive to cultivate himself.
Accordingly, for farmers, the cost of having animals is likely to decrease with intensification and crop-livestock competition should, therefore, also diminish, at least temporarily.
This stage of mixed farming, roughly corresponding to Powell and Williams' 2nd stage, is typical of semi-arid and sub-humid environments. The high rainfall semi-arid zone and the sub-humid zone are ideal for the integration of animal husbandry and crop farming (Jahnke, 1982:132). Especially the sub-humid regions have experienced a heavy increase in animal populations due to immigration and the gradual reduction of the tsetse fly populations that cause Trypanosomiasis. Integration is helping to keep the tsetse fly at bay. The thinning out of the woody vegetation associated with the expansion of cultivation destroys the breeding grounds of the tsetse fly which depend on the shade of the trees[18] (Ruthenberg and MacArthur, 1980:85; Pingali *et al,* 1987:41; Powell and Williams, 1993:26; Bourn and Wint, 1994b: 13). Expansion and intensification are, therefore, in this respect facilitating the spread of animal husbandry.

As the intensification process progresses, livestock will, according to the Boserup model, become increasingly dependent on labour-intensive feeding systems like fodder cultivation, cut grass and browse, and crop residue. Their value will increasingly be acknowledged as suppliers of draft power, manure and milk rather than accumulation of capital value as would be typical under less intensive systems (Mortimore, 1993b: 17). Actual intensification of livestock may consist in feeding on cultivated fodder, stable feeding, or to a higher degree being fed with purchased inputs. It follows that low-input livestock systems are likely to disappear when faced with land scarcity and increased resource competition between livestock and crops (Kaufmann and Shapiro, 1994:2). This type of mixed farming, roughly corresponding to Powell and Williams' 3rd stage, is typically found in the highlands especially of East and Southern Africa. In the humid tropics animal husbandry is restricted by diseases (Powell and Williams, 1993:26).

[18] Though attention should be given to the possible multi-collinearity of government eradication programmes more likely to be executed in densely populated regions and the role of drought in reducing habitat for the fly (Sumberg, 1994:11).

The return to specialisation as mentioned in the 4th stage may arise when the markets continue to develop and inorganic fertilisers eliminate the need for manure, tractors the need for animal traction and cultivated forages and diet supplements the need for crop residue. The incentive for the farmer to produce his own inputs thereby diminishes and it becomes more profitable to specialise (Powell and Williams, 1993:24).

A similar succession of livestock intensification has been described by Mary Tiffen (1994:4) partly with reference to the Machakos study (Tiffen *et al,* 1994). Here, five stages are used to distinguish the different intensity levels:

- Pastoralist system where population density is low, commercialisation difficult and labour and capital scarce.
- Ranches where labour remains scarce but capital for fencing systems and water points is more readily available.
- Agro-pastoralism where subsistence cropping near a fixed home is combined with extensive management of livestock over a large area.
- Commercialised mixed farming where animals on private enclosures are fed by a combination of grazing and crop residue.
- Further stage of intensity where animals are tied or penned, and fed with crop residues and cut (and often grown) fodder.

Though mixed farming has been promoted in semi-arid West Africa for many years, low adoption rates have pointed to some limitations in the practicality of the model. Turner (1993:437) lists a number of these limitations, of which the most important are labour availability as a limiting factor rather than land, implicit assumptions of access to external inputs like fertilisers, feed supplements and improved seeds, the costs of decreased rangeland productivity, the lack of specialised knowledge required for successful animal husbandry, and the importance of off-farm income as an alternative to the increased labour requirements associated with the agricultural intensification.

However, the close relationship between mixed farming and agricultural intensification has been supported by empirical studies. A recent study by Bourn and Wint (1994b) showed a statistically significant positive correlation between livestock biomass, intensity of land use and density of human populations.[19] These findings indicate that animal husbandry is part of the intensification process itself. The authors propose that the findings may be seen as consistent with the Boserup hypothesis of autonomous intensification through initial coexistence and

[19] The maximum livestock biomass was actually found at 825mm precipitation, which correlates well with the present study area.

gradual integration of animal husbandry within local farming systems (Ibid.: 12). The attractions for having animal husbandry in connection with agriculture are better access to fodder resources on fallow land and crop residues, proximity to markets and services and in some cases the availability of water (Bourn and Wint, 1994a:32). Though the comparability of the chosen agro-ecological zones studied can be questioned (Turner, 1994:22), the study may support the trend of high livestock densities that are managed under situations of high human population densities and thus intensive agricultural systems.

However, with intensification and a growing population, livestock per household may be expected to decrease. Murton (1999:40) describes how the transition to zero-grazing in the Machakos district in Kenya, allowed the stocking density of cattle per hectare to increase, while the total land allotted to grazing decreased at the same time as numbers of livestock per household fell. He also describes how the widespread adoption of terraces tended to hinder the use of plough, which is why the degree of mechanisation fell dramatically, thus rendering animal husbandry superfluous in this respect.

Another consequence of intensified animal husbandry was that women's role regarding animal husbandry was seen to change in Machakos. The traditional female tasks of milking and foddering became, with the transition to zero grazing, more important than the male tasks of herding and guarding. As the women were successful in keeping these tasks in their domain, they gained more control over animal husbandry and the money from dairy sales (Murton, 1999:40).

The Bourn and Wint study showed a close correlation between livestock and human population. An interesting questing however, also raised by Ian Scoones (1994a: 13) would be then: from where do all the animals in the closely-settled areas get their feed? If the animals get their feed from natural grazing then large areas must be set aside for grazing as noted by Boserup (1965:35) in connection with the introduction of draught animals under short-fallow. Crop residue may provide a better grazing resource than natural grazing (Mclntire *et al,* 1992:43; Scoones, 1994a: 13; Powell and Williams, 1993:27), but then careful management of these and other key resources becomes imperative (Scoones, 1994a: 13), something that Toulmin (1994:17) considers perfectly possible. A consequence hereof may be the need for a relatively high degree of mobility, especially during the rainy season when the animals must be kept well away from the crops in order not to induce serious damage.

The demand for flexibility and mobility will therefore not diminish with the intensification of the agricultural system. The flexibility needed to cope with an abnormal year may be maintained and animal herding may become very labour demanding, as the herder has to be vigilant in order to prevent stray animals from damaging the crops in the densely-cultivated areas. The obstruction of cattle corridors, few patchy pastures left over from agricultural expansion,

and cultivation in the low-lands make mobility an important aspect of animal husbandry, even in the densely-cultivated, semi-arid and sub-humid regions. Though the pastoralists may be permanently settled, this may therefore not be equivalent to actual sédentarisation. This is not to be mistaken for later stages of mixed farming with paddocked animals permanently on the farm (Scoones, 1994a: 13).

One thing is to provide livestock with adequate grazing, another is to supply fields with sufficient nutrients, especially Nitrogen (N) and Phosphorus (P). The transfer of nutrients to fields through manure is central to the idea of mixed farming and should in principle allow for sustainable cultivation on a permanent basis. However, it is highly questionable whether a sustainable mixed farming system based on nutrient imports from rangelands is at all possible. It should be clear that feeding animals on crop residue alone cannot sustain the required nutrient level on a long-term basis. The nutrients taken away with the harvest should be replaced by the nutrients supplied by the grazing cattle, and even if it is assumed that the nutrient cycling in this way becomes much more efficient there would still be a significant loss due to leaching and volatilisation. Animals will remove a greater amount of biomass and nutrients than they return in the form of manure (Powell and Williams, 1993:27), hence fertility maintenance through manuring alone can only be done through nutrient imports from rangelands (Turner, 1993:439). The ratio of rangeland to cropland that is needed to supply the required nutrients to a field exclusively through manure and urine have been calculated to be between 10 and 30[20], which translates into a cropping fraction of 4-9% (Turner, 1993:442). That is, if a village should rely solely on manure for the nutrient supply to the fields, they would not be able to cultivate more than 9% at most of the land available. Of course, the rangeland to cropland ratio is uncertain as several of the components in the equation, including carrying capacity, are difficult to estimate with sufficient accuracy and the management system applied also has a significant influence. However, the basic conclusion of these calculations is that sustainable fertility maintenance in a mixed farming system is not possible without external inputs in the form of inorganic fertilisers or feed supplements (Ibid.:448).

Heavy reliance on rangeland grazing as a supplier of crop nutrients also increases the pressure on the rangelands. With higher cultivation densities following intensification through mixed farming less rangeland will be available for the animals. During the dry season, the animals should be able to feed on the crop residue but during the rainy season the rangeland will become the key to avoiding crop damage. More animals on less rangeland concentrated in a short rainy season when the grasses also need to reconstitute after the dry season, implies an obvious risk of rangeland degradation inherent in the mixed farming model (Turner, 1993:436,440).

[20] Powell and Williams (1993:29) mention ratios of 4-40, but as they do not yield details on the background of these figures, the figures from Turner are used here.

In contrast to the above arguments, a recent study in the Kano close-settled zone in Nigeria (Harris, 1998; Harris, 1996) showed that this intensive agricultural system with a population density of more than 250 inhabitants/km^2 and cropping intensity of 86% was sustainable in terms of nutrient cycling due to a high degree of integration of animal husbandry and agriculture. However, the study also revealed a nitrogen deficit during the two-year study period, of which one year was relatively dry which means that less nutrients were removed with the limited harvest. As inorganic fertiliser was also used in modest quantities and as off-farm work was used by some farmers, the study does not offer a convincing alternative to the above arguments, but does nevertheless point to the potential of mixed fanning, especially the significance of an efficient management system.

As the stages of mixed farming correspond closely to the stages of agricultural intensification, they rest on the same critical preconditions discussed previously (page 43). If the stages are perceived as a deterministic development process it may be overlooked that this process is not naturally given and that some of the mechanisms driving the process may not come into effect if these preconditions are not fulfilled. Besides, the expectations of the benefits and the evolution of mixed farming has provided a justification to governments for indifference towards protection of e.g. cattle corridors used by transhumant pastoralists which neglects the probable increased demand for flexibility and mobility associated with mixed farming (Turner, 1993:448). Furthermore, the nutrient self-sufficiency and environmental impact of mixed farming systems can be seriously questioned.

Mixed farming may also be dependent on other critical preconditions. One of these is the availability of labour required for the maintenance of the animals. As will be shown, this is specifically relevant for the study area and will be discussed further in the section on entrustment.

Animal traction is one of the main motives for the farmer to acquire livestock. However, as will be shown in a subsequent section, the benefits for farmers are ambiguous. Another important factor is off-farm income opportunities that in many parts of semi-arid West Africa would make labour-intensive mixed farming less appealing, as was discussed in a previous section (page 36).

One important aspect in relation to this is that conflicts between farmers and pastoralists may arise due to competition over resources. Conflicts are apparent in the study area and have a significant negative effect on the feasibility for the farmer of having animal husbandry through an undermining of the entrusting system, as will be illustrated during the analysis of the primary data. In the following, though, a brief outline will be given of more general characteristic of conflicts that are likely to accompany mixed farming developments.

1. Conflicts

As discussed, mixed farming will, according to the agricultural intensification model, evolve as a response to increased population densities and intensified agricultural production systems. In the very early stage where it merely involves interaction between farmer and pastoral specialists, there are good possibilities for complementary and mutual advantage e.g. in the exchange of manure and milk for water and grain. However, when interaction gradually transforms into integration the farmer and the pastoralist increasingly become dependent on the same resources, hence the potential for conflicts rises (Toulmin, 1983:21). Conflicts between farmers and pastoralist could be a result of increasing difficulties for the herder to find pastures for the animals, and because the farmer will increasingly reserve his crop residue for his own animals. In addition, animals herded by the pastoralist are at risk of entering the fields of the farmer during the cropping season and destroying the crops. The southward movement of the pastoralists has led to many conflicts of this sort and they are also common in the study area (Faho, 1995; Delgado, 1979a: 154; Faure, 1990:348; Breusers and Nederlof, 1998; de Haan *et al,* 1990:57; de Haan, 1998; Basse«, 1988; Powell and Williams, 1993:24; Lund, 1996; McMillan *etal,* 1993:90; Own data).

In the study area, several sources of conflict have been identified, of which the most important is the divagation of animals into the Bisa fields during the rainy season leading to serious crop damage. However, bushfire, the cutting of cattle-corridors, the gathering of crop residue, deaths and theft of animals entrusted to the pastoralist, access to water and land and simple envy can also lead to conflicts. In his useful review, Hussein (1998) identifies several more by classifying them into ultimate (systemic, structural and historical factors) and proximate (factors more directly leading to conflicts) causes at both macro and micro level. According to this classification, all the mentioned causes of conflicts identified in the study area would be micro-level proximate causes, and more ultimate causes would be the ongoing expansion process, population pressure, ethnic differences, and the increased pressure on the rangelands.

Depending on the stage of integration, the mixed farming system may also have reconciling effects as the farmer and the pastoralist to some degree receive mutual benefits from one another. The farmer needs the manure from the pastoralist's animals, and the pastoralist needs the crop residue from the farmer's field. However, various transactions between them such as trade and barter, labour exchange, paid ploughing of fields, pastoralists treating diseases of sick farmer animals, and entrusting may contribute to a peaceful co-existence. The entrustment system is especially interesting and relevant for the study area, and may be instrumental in fomenting a good relationship (Delgado, 1979a:314), but it is however also very vulnerable to animosities provoked by other incidents.[21]

[21] Entrusting will be dealt with in a subsequent chapter (page 63)

Though there are reasons to believe that conflicts between pastoralists and farmers have increased with agricultural expansion in general (Brink *et al,* 1995:389; McMillan *et al,* 1993:90) some researchers have, based on historical data, questioned whether this is actually the case (Sumberg, 1994:9; Hussein, 1998:57). However, with the increasing number of animals in densely cultivated semi-arid and sub-humid zones, it would be surprising if conflicts had not become more pronounced. Also, in the study area a closer examination of the sources of conflicts points to increasing frequency of conflict incidents (chapter VII.B.8, page 182). Conflicts have been used by local authorities as an opportunity to introduce policy intervention, often not in favour of the pastoralists, but Cousins (1996:43) is probably right in agreeing with Scoones (1994c) that conflicts should *"be addressed and accepted as inevitable rather than being ignored or treated as an incidental or removable feature"* which may help in understanding their nature and thus creating or supporting conflict-resolving institutions.

It may, however, be tempting to see these sorts of conflicts as part of the natural and positive transformation of production systems and that policy interventions may in reality remove the conditions for endogenous generation of long-term solutions to conflicts. Though endogenous solutions to conflicts probably will develop, this does nothing to ensure that the most well-adapted or most beneficial land use system in terms of national development strategies or environmental sustainability is maintained. If the conflicts and their solutions are left to some sort of natural evolution, it is most likely that in the study area pastoralism will cease to exist in favour of extensive subsistence agriculture with important losses in terms of opportunity costs as a consequence. Besides, development through conflicts is neither desirable nor justifiable in a world that increasingly seeks to establish consensus by peaceful means.

2. Animal traction

In the study area, there is no prevalent use of advanced technologies like machines, high yielding varieties, fertiliser and pesticide packages etc. The most noticeable agricultural technology is the use of animal traction for the preparation and to some extent weeding of the fields and for transport of the harvest on carts. The introduction of animal traction in a farming system is closely related to the more general development of the system from long-fallow to short-fallow or permanent cultivation, or in other words emerging intensification and expansion. The preceding section discussed how this process takes the form of mixed farming, and that animal traction is one of the most important factors driving the integration of farming and animal husbandry. The aim of the present section is to single out some of the specific factors determining the adoption, use, or abandonment of animal traction, as this is one of the important processes in the study area that has serious consequences for pastoralism in the region.

Animal traction is often seen as part of a mechanisation process going from the planting stick to the tractor. The transition from animal traction to tractor under permanent cultivation, is

dependent on locally-specific cost-benefit relations rather than the evolutionary stage of the agricultural system (Pingali *et al,* 1987:7). Important factors here are the availability of machines,[22] credit opportunities, size of the land-holding and the individual fields, cost of further destumping,[23] infrastructure, maintenance costs, fuel prize, fodder availability and animal markets etc. In this section, however, the machine stage of the mechanisation process is not considered, as it is almost non-existent in the study area.

The adoption and adaptation of animal traction is determined by several factors. The level of intensification is instrumental, but also many locality-specific factors are important.
As mentioned in the discussion on Boserup and intensification, the adoption of animal traction in forest- or bush-fallow systems would not be cost-effective as roots, logs and tree-trunks would hamper the use of the plough and be too labour-demanding to remove compared to the alternative of using the hoe (Binswanger and Pingali, 1985:78). However, with shorter fallow, the big roots and trunk density decrease, and almost disappear under grass-fallow systems. As grassroots are not removed by fire and are arduous to remove with the hoe, the animal-drawn plough may become profitable. Under grass-fallow trypanosomiasis will also be less of a problem, and more grass will be available for feeding the livestock (Pingali *et al,* 1987:6). Likewise the connection is established to population density, as intensification by and large can be seen as a variable thereof. A certain population density has to be reached before the extra costs of acquisition of the animals and the plough, training of the animals, cost of destumping and levelling the fields, and the cost of feeding and maintaining the animals are justified (Boserup, 1965:34; Pingali *et al,* 1987:33). With further intensification the use of the plough is likely to diminish, as the maintenance costs of the animals increases as grazing land becomes scarce, the animals change role to be primarily milk and meat producers, and as terraces, which is a common soil-conservation measure in connection with intensification, hinder the use of the plough which may result in farmers reverting to more simple technologies such as hoeing (Murton, 1999:40).[24]

The locality-specific conditions of importance for the adoption of animal traction are related to soil, climate, markets for animals and their by-products, prices, maintenance costs, credit availability etc.
Pingali et al. (1987:59-62) and Binswanger and Pingali (1985:68-74) have illustrated the influence of the soil by looking at changing land use in relation to the topo-sequence or catena.

[22] Under systems with short growing seasons as is the case of Boulgou, the rental of machinery is not likely to be feasible because of time conflicts of the potential users (all have to plough at the same short time-interval) and the difficulties of spreading the operation, hence the costs of the machines over time and space.
[23] Tractors require that the fields are more elaborately cleared of roots and other obstacles than do the animal drawn plough as the latter is far more manoeuvrable and flexible.
[24] Hindrance due to terracing is generally less of a problem in the relatively flat West African landscape compared to East Africa from which the empirical data for the reference originate.

During their field-visits they found a correlation between this sequence of soil composition and the use of ploughs. Briefly explained, the topo-sequence as they used it ranges from sandy shallow soil at the top to deeper loamy soil mid-slope and heavy deep clay at the bottom. The top will be easiest to labour, but the low water-retention capacity also increases the risk of crop failure. At the bottom, the power needed for tillage will be large, hence the need for animal traction will be greatest, but also investments in water control and drainage will be necessary due to the risk of water logging. However, the overall risk is lower at the bottom as water is available and the soil retains the water well. The mid-slope is in-between these two extremes and offers relatively good conditions considering the combination of risk and required labour, and these are the areas that, except under arid conditions, will be cultivated first. The scale of the model may range from sub-regional to cover several regions and agro-climatic zones.

When population density increases on the mid-slope, communities have the choice of staying mid-slope and intensifying, moving upwards and investing in erosion control, or moving downwards and investing in drainage and water control. The highest returns to investment will typically be found in the valley bottom or lower slopes, hence it is here that investments will be made. As these areas are very labour-demanding to cultivate, the shift to animal traction will give high returns, hence the plough is most likely to be adopted when these areas are being cultivated. Typically the use of the plough only spreads to the other soil-types after it has become well-established in the valley bottoms. Thus, there exists a close correlation between the available soil-types, the adoption of the plough, and the intensification of the farming system.

The catena development model as presented by Pingali et al. does, however, like the hypothesis of Boserup, indicate a rather deterministic development pattern. Though compelling as a simplistic model, there may well be factors than the mere correlation between soil characteristics and animal traction influencing the process in a more latent form, and thus harder to discern, a phenomenon also labelled multi-colinearity. An obvious weakness in the empirical background to the mentioned study is the lack of site-specific temporal coverage. The study of the evolution of farming systems can be paraphrased as the changes over time that the system is going through, which is why, as noted by Sumberg (1994:10), the comparison of sites from different agro-climatic zones *"..only makes sense if one is willing to believe that the sites are representative of different stages along a single development path"*. In other words, had the theory not been pre-conceived, it is not likely that the comparison of the different sites would show anything except a number of examples of adaptations to a local context. The results of the study may be convincing, but more due to the logic of the explanations offered than to an indication of correlation. For such a conclusion the data would have had more value had they covered just a few sites, but with a longer time-series.

Climate also has an important role to play that will be broadly outlined here, again based on the study of Pingali et al. (1987:65-69).
Under arid conditions, the growing season is very short and the timing of sowing and weeding is crucial. Peak periods of labour demand such as weeding and harvesting are determining for the yields, which is why extra labour demands induced by the animal traction may become a limiting factor[25] (Delgado and Mclntire, 1982:189). The work needed for maintenance of the animals during the dry non-agricultural season may, furthermore, induce high opportunity costs for the farmer, as seasonal off-farm migrant work, especially by the young men, is widespread in arid and semi-arid regions and constitutes an important source of revenue for the household (Ibid.: 190). The soils used in arid and semi-arid environments are often light and can be prepared relatively easily, if at all, with the hoe or more recently with the hiler[26]. If the soil had to be ploughed first, sowing may be delayed which would translate into a decreased harvest. The benefits from the better preparation of the soil, e.g. improvements to the structure and aeration, must outweigh the decreased yield due to an effectively shorter growing season. Farmers in arid climates are therefore less likely to adopt animal traction.

In humid regions this time constraint is not present, but typical soils suffer from leaching and acidification under permanent cultivation, hence such investments are less likely. Furthermore, Trypanosomiasis may be a serious hindrance. Mixed cropping, which is the most common agricultural practice in such climates, is not suitable for animal traction as the labour requirements of the different crops do not coincide.

In semi-arid climates, capacity utilisation becomes a hindrance, as it will be difficult for the farmer to spread the costs of acquisition and maintenance over time and space sufficiently, as the growing season is too limited. However, in the higher rainfall regime of this climate the best conditions for animal traction may be found, as the growing season may be long enough to compensate here, and at the same time the constraints mentioned for humid climates are less relevant.
It should be noted that for all three climates mentioned here, which of course is only a crude outline of reality and may only serve to illustrate some of the relationships, due allowance must be made for the soil conditions, as discussed above.

The other mentioned locally-specific conditions for adoption of animal traction concern operation costs. As mentioned, a certain population density should be reached before the extra costs are justified. This point, however, may be influenced by local cost factors. If, for exam-

[25] The extra work may stem from maintenance of the animals, more weeding as ox-drawn weeding demands more spacing between rows which increases weed growth, and increased harvest as result of the expanded area.
[26] The *hiler* is a half-moon-shaped tool that allows faster weeding than the hoe. However, the soil is not turned over, hence the soil structure is not improved. It is only suited for light soils, and may be seen as a typical instrument in an expansion process (Guillaud, 1989; Guillaud, 1993).

pie, there exists a well-developed market for meat and the animals therefore attain high prices, this will tend to make animal traction attractive for the farmer at an earlier stage. Accessibility to credit and the availability of cheap fodder opportunities e.g. grazing land in a common or open-access tenure regime, will also tend to further the adoption of animal traction. Heavy soils arduous to cultivate or high fertility maintenance requirements will also have this effect (Pingalie? *al,* 1987:35).

It should be clear from the preceding paragraphs that animal traction is far from economically rational in all African contexts. Compared to Europe, where generally better soils and agro-climatic conditions led to the widespread adoption of animal traction in a rather uniform and straightforward pattern, the continued use of the hoe and planting stick in Africa has led to false assumptions concerning the primitive level of African agriculture and the lack of skills and stubbornness of the African farmer. Lack of mechanisation has typically been seen as backwardness and incompatible with modern industrial development. Many attempts have been made to mechanise African farming through government or donor-sponsored development schemes of different sorts, but many of these have met with little success (Berry, 1993:182). The relationships between intensification, soil and climate may explain why this has been the case. There are, however, other assumptions about the lack of mechanisation that deserve attention.

The lack of mechanical skills and repair services is one such assumption. However, as Pingali et al. (1987:90) rightfully point out, there has been no constraint on the spread of diesel motor-driven mills or the use of motorcycles, cars and trucks. It should be reasonable to assume that if local communities can make major repairs and maintenance on such machinery, they can also handle a plough.

Lack of skills in animal husbandry could be imagined as a constraint. However, many better-off farmers already own cattle for investment or saving, and must therefore be assumed to know how to treat them. Nevertheless, it may be a risk for the fanner to invest in cattle without knowledge of how to treat diseases etc. Though veterinary services are common in rural Africa today and the farmer is therefore not alone in case of problems, the risk of the total loss of a relatively large investment due to disease may influence the farmer's decision against adopting animal traction. An important factor that may significantly improve both the health and condition of the animal, as well as free human labour for other tasks, is the entrustment system where the farmers leave their animals with the pastoralists when they are not used in the fields.

Cultural preference has also been used as an explanation. However, with the large change in livelihood that e.g. the Fulani have undergone in recent years with the adoption of crop cultivation, this can hardly be characterised as a determining factor unless the choice is rather sub-

tie. The study of Pingali et al. (1987:94) was not able to find any significant cultural barriers to the adoption of animal traction.

Some of the above-mentioned assumptions can be heard expressed by the villagers themselves. This does not necessarily mean that villagers are not telling the truth, but could possibly be seen as a more politically-determined expression, since foreigners are almost automatically perceived as part of the donor community. There is not really anything that suggests that the average African farmer is not willing to adopt new technologies should the cost-benefit relations and the risk considerations be in favour hereof.

The modest size of trypanosomiasis-resistant cattle, e.g. the N'Dama and the Baoule used in the more humid environments, may make them less suitable for traction. Pingali et al. (1987:94) cites several sources who claim that the endurance of these cattle depends more on their environment than their breed. However, this may raise the maintenance costs of the smaller cattle compared to the larger Zebu, as the demands to their physical condition may be higher. Research in crossbreeds between the Zebu and the trypanosomiasis-tolerant breeds is a fast-evolving area. ILRI (International Livestock Research Institute, Addis Ababa and Nairobi) has, with the help of gene-marker-technology, recently identified regions of the cattle genome contributing to the control of trypanosomiasis infections in a crossbreed of trypanotolerant N'Dama cattle and trypanosusceptible Boran cattle. If these genes can be maintained in new breeds it is possible that this constraint on the spread of animal husbandry to the more humid environments may be less of a hindrance in the future.[27] However, other factors will not necessarily disappear, as will be discussed in subsequent sections.

The lack of fodder could be expected to become a problem as the agricultural system intensifies (Scoones, 1994a: 13). Pingali et al. (1987:96) do not see this to be a problem, as the levels of intensity found in Africa are not sufficient to make crop/fodder competition a highly limiting factor. However, as grazing necessarily takes up space that will soon become an important constraint, and as the remaining grazing areas are likely to be subject to competition from other user-groups e.g. the pastoralists, this may, in fact, still be a limiting factor. It should be borne in mind that the adoption of animal traction is likely to appear in connection with expansion and therefore rather early in the intensification process, which is why fodder cultivation and zero-grazing will probably not be feasible at this early stage. Providing fodder of adequate quality and quantity for the animals may therefore be a significant cost, influencing the decision to adopt animal traction or not. This is another area where entrusting may prove to have a major influence.

[27] For a description of the ILRI Bioscience programme, see http://www.cgiar.org/ilri/mtp/proj2/fsp02b.pdf

Animal traction is generally adopted primarily for providing transport and thereafter for land preparation etc. (Cleaver and Schreiber, 1994:138; Pingali *et al.,* 1987:56). The change from hand-hoe to ox-drawn plough cultivation is usually motivated by the need for expansion or to economise on work-input in connection with land preparation, weeding and transport (Pingali *et al.,* 1987:7, 9, 104). However, the total labour requirement per hectare will not neccesarily fall. As mentioned in the discussion on animal traction under arid climates, the increased area also demands more weeding and harvesting, and the animals require maintenance. The maintenance costs in particular may be sufficiently large to be prohibitive on small, labour-constrained millet-sorghum farms (Delgado and Mclntire, 1982:195).
Yet as the adoption of animal traction must be seen in relation to the intensification and expansion of the overall agricultural system, some of the extra work required may be ascribed to intensification rather than directly to mechanisation. Though an obscure division, it may be assumed that the primary benefit of the introduction of animal traction is an initial increase in work productivity, be it in relation to transport or tillage.

The general workload per household member will be largely dependent on the degree of expansion. Holding the area constant, the above implies that the work-load/person would decrease. However, if the cash-requirements of the household and the area thus expanded in e.g. cash-crops increases, the workload may instead increase. The shift in peak labour requirements for weeding and harvesting may result in increased overall work for the household (Pingali *et al.,* 1987:106). Yet even if the shift in peak labour periods does not offset the work-hour gain, the inclusion of animal maintenance will (Delgado, 1989:365).
Thus, although animal traction in itself would be expected to lower the workload/person, this is only likely to be true if all other variables are held constant.

The adoption of animal traction represents a considerable investment that may be out of the reach of the average farmer. Credits in some form will normally be a precondition and the refunding hereof will require a certain security. In case of a bad harvest, the farmer may not be able to pay his debts, with all the repercussions this may have. The adoption of animal traction may, therefore, also be associated with considerable risk. The resource-poor small-scale farmers are therefore not likely to be first in the queue for taking on animal traction. The farmers with the largest area cultivated, the largest household, access to off-farm income, and who already own several animals suitable for traction will be the typical, if not the only, first adopters. Like with the "green revolution" this may lead to a widening of the social differences in the village society. Furthermore, the profitability of acquiring animals for traction and tools is likely to decrease as the market for renting out equipment or paid labour will narrow down as more fanners acquire their own equipment (Faure and Djagni, 1989:70), a relationship also identified in the Kano Close Settled Zone in Nigeria (Harris, 1996:10).

Generally, the change from the hand hoe to the animal-drawn plough is not accompanied by increasing yields (Pingali *et ai,* 1987:102; Faure and Djagni, 1989:69; Mclntire, 1983:10). Though tillage quality may be better with animal traction, it is possible to do just as good a tillage by hand, which is why the focus should not be on the tools itself, but on whether they lead to better practices. Experiments have shown improvements especially on heavy soils, but field surveys have only shown a minimal effect. There is, therefore, no reason to believe that the adoption of animal traction leads to better tillage, hence the expectation of higher yields cannot be a valid motivation for the farmer to make the change.

Empirical studies have shown that the economical return to the animal-drawn plough is highest in connection with cash-crops like cotton, rice, and groundnut, and lowest when used in the cultivation of typical subsistence crops like millet and sorghum (Pingali *et al,* 1987:65; Delgado and Mclntire, 1982:192). It has furthermore been shown that the cost of acquisition of the animals and equipment, and hence the refunding of the credit, will increase the farmers' need for cash-providing crops. The expansion that is common with the adoption of animal traction is thus likely to result in an increase in the area sown with cash-crops (Faure and Djagni, 1989:65; Delgado and Mclntire, 1982:194). It has, furthermore, been shown that animal traction is not likely to be economically feasible for the average farmer unless it is accompanied by other technical or economic improvements (Ibid.). The modelling of Delgado (1979a:302) from the present study region also showed that *"Under the most favourable assumptions, the maximum attainable increase in farm revenue from using animal traction was only of the order of three percent of the total annual revenue without keeping cattle."* which was primarily due to the peak labour demands during the time of the harvest which resulted in high opportunity costs related to the maintenance of the animals (Delgado, 1979a:275). Animal traction, therefore, is not a technology that can be assumed to be adopted autonomously as the profitability in many less favourable agro-ecological regions is highly questionable.

Expansion is common in connection with the adoption of the plough (Mclntire, 1983:10). Pingali et al. (1987:101) found that the average land holding had doubled after the introduction of the plough. Whether this also leads to an increase in the aggregate area cultivated depends on whether the expansion is done through the acquisition of other farmers' land or the inclusion of virgin or fallow land. They do not have a clear answer to this question but suggest that in areas with abundant land, expansion is most likely and vice versa in more populated regions.[28] This is partly confirmed in a study from Northern Togo (Faure and Djagni, 1989:66) and from Burkina Faso (Delgado, 1989:355), where the adoption of the plough did not lead to increases in the cultivated area per household member, while another study from Burkina Faso did find an area increase (Mclntire, 1983:4). In Togo this was due to increases in

[28] Note that Pingali et al. treat the cultivation of fallow land as expansion, which is not consistent with the definition adopted in the present study (see page 20).

the number of young and relatively inefficient household members and the pressure on the land, as almost all cultivable land was already being cultivated. The expansion that did occur was mainly through borrowing or renting land from other members of the local society (Faure and Djagni, 1989:66).

Thus, to summarise the consequences of the introduction of animal traction the following simplified relationships may be observed:

Cult. Area	Total Outp	Outp/Area	Outp/W-H	Outp/Pers	W-H/Area	W-H/Pers
Up	Up	NU	Up	Up	Down	Down

Table 2 Simplified consequences of the adoption of animal traction. Outp stands for output, W-H for work-hour, and Pers for number of members in the household.

The table is constructed from the above general arguments. It should be noted, therefore, that though of course applicable to all the relationships mentioned, especially the working productivity and related factors are subject to variations and uncertainties, and are prone to influences from locality-specific preconditions. The cultivated area is expected to increase as the farmer can work faster in the field and it therefore also follows that the total output will increase while the yield or the output per area will remain constant as the possibly improved tillage has not been proved to lead to increased yields. As the farmer can work faster, his working productivity (Outp/W-H) is likely to rise, though the extra work needed for maintenance of the animals may reduce this benefit considerably and even eliminate it completely. If the increased productivity is accepted it follows that the output per person also increases while the hours that must be put into working the land decrease. Therefore, the work demanded per person will also decrease.

a) Summary

Animal traction is a technological innovation that may be expected to occur early in the intensification process as part of agricultural expansion. It is often associated with the provision of transport with carts, and its profitability may depend heavily on the income that may be generated from renting the equipment, including the animals, or performing tillage for others. The yield is not expected to be influenced by the adoption of animal traction, but the workload of the farmer may be lightened. The adoption of animal traction is most likely to appear in higher rainfall regimes in semi-arid environments, and primarily among the better-off larger households already in possession of animals or with access to off-farm income. The acquisition of animals and tools is likely to further the cultivation of cash crops. The expansion associated with the adoption of animal traction is thus primarily reflected in a larger area under cash cropping. The advantages and feasibility of animal traction are therefore dubious and as this is one of the most important justifications for mixed fanning it also questions the feasibility of this model.

One of the major bottlenecks for the adoption of animal traction is the labour requirement especially in peak periods in the agricultural calendar. One way to keep the animal husbandry-related labour requirement at a minimum is to enter into contracts with specialised herders to take care of the animals. This so-called entrustment system is widespread in the study area and will be discussed in the following section.

3. *Entrustment as an alternative to mixed farming?*

Entrustment, also called herding contracts (French: vache d'attache, contrats de gardiennage or confiage), is a more-or-less formai arrangement between the farmer and the pastoralist where the farmer leaves some or all of his animals in the custody of the pastoralists for shorter or longer periods. Such arrangements are common in West Africa and some general figures suggest that around half the cattle in the Sahelian countries may be owned by non-pastoralists (Bayer and Waters-Bayer, 1994:65) while Pons (1988) suggests that in some areas of Burkina Faso between 50 and 80% of the cattle is under this kind of ownership and a large part of those are kept in some sort of entrustment arrangement. A gradual change of ownership of animals from pastoralists to farmers has been taking place in the Sahelian and Soudanian zones of West Africa for most of the 20th century (Thébaud, 1988:95). After the droughts affecting most of the Sahel in the early seventies and eighties,[29] this process of change of ownership has accelerated as the pastoralists were forced to sell a large part of their herds, often at low prices (Dijk, 1994:105; Bruijn and Dijk, 1992:46; Bayer and Waters-Bayer, 1994:65; Turner, 1992:9; Brink *et al,* 1995:390; Kintz, 1982:216; Bonfiglioli, 1990:255; Toulmin, 1983:15; Toulmin, 1992:9; Thébaud, 1988:95). This has led to a crisis in pastoralism with marginalisation and impoverishment of the pastoralists and a widespread sédentarisation of the nomadic pastoralists. The pastoralists have been forced to settle either in marginal areas with meagre agricultural potential or in areas where complementary links to the farming society could be exploited.

> *"Leur (les éleveurs) sédentarisation ne peut donc se faire que sur des terres marginales, peu productives et où l'élevage est une activité économique complémentaire essentielle à la viabilité des unités domestiques. Cette sédentarisation évoluerait ainsi vers l'extension de l'agro-pastralisme alors que ce système est déjà en crise face à la réduction de l'espace et à la pression des agriculteurs. " (Thébaud, 1988:109 parenthesis added)*

This sédentarisation implies that pastoralists increasingly adopt farming which results in an agro-pastoral system. As noted by Thébaud above, this process has been made difficult by agricultural expansion.

[29] Laya (1975) has published transcripts of interviews with Niger pastoralists who fled to Niamey following the 1972-74 drought which give a close to "first-hand" impression of their catastrophic situation at the time.

The change of ownership consisted not only of farmers acquiring the animals of the pastoralists but urban dwellers also saw an opportunity to profit on the high interest rates of 10-20% (Bayer and Waters-Bayer, 1994:65; Delgado, 1979a:314) associated with cattle. The farmers and the typically urban-based absentee owners often do not have the means to herd the animals, hence it is common that the pastoralists take care of this. With this rise in entrustment the pastoralist become proletarised, or enter a sort of tenancy system, which is most often seen as a negative arrangement that the pastoralist is only entering into because of bis distressed situation.

However, many forms of these arrangements exist. In Niger, Thébaud (1988:94) encountered more than 30 different kinds of arrangements in only 7 villages. Furthermore, there is a marked difference between a destitute herder entering into tenancy arrangements with absentee owners, and a herder who takes care of animals that his neighbour the farmer has entrusted to him, thus exploiting a complementarity between the two groups. Thus, it is necessary to make a distinction between various forms of entrustment because there are some basic differences:

1) Absentee owners do not normally care for anything but the profit the animals can yield and do not therefore have any personal relationship with the pastoralist looking after his cattle.
2) Entrustment in the study area, on the contrary, is a local phenomenon most often building on life-long relationships between the farmer and the pastoralist. It is, therefore, conducive to a good relationship between the two and may therefore be a basis for exploitation of mutual benefits.
3) The animal husbandry of the local farmer is more than just an investment opportunity. It is also his personal security and savings, but more importantly it is often also an active part of his crop-farming system. As will be shown, entrustment is important for the feasibility of the farmer's having animals for draft power because of labour-related opportunity costs. Draft power is essential for the agricultural intensification model, and the pastoralist therefore has a central role to play in agricultural development in the region. The entrustment system is therefore an integral part of agricultural land use systems.
4) Through entrustment, and the important role the pastoralist thereby takes on in agricultural development, the power and influence of the pastoralist is also maintained. As many farmers depend on the services of the pastoralists, the latter will be able to exert influence that will enable him to claim usufruct and property rights over land and other resources. As the pastoralists are often politically marginalized, this may be their only chance of gaining acceptable tenure security.

Thus, there are important differences between absentee ownership of cattle and the entrustment arrangements that are integrated in local land use. In the present study area, complemen-

tary links between farmer and pastoralist have a long history and are still important factors for both. Therefore, the specific form of entrustment found in the study area will be discussed here. Though there are problems inherent in this system, it is predominantly seen as an arrangement with important positive effects for the feasibility of animal husbandry in the region, and therefore also for the prospects of further agricultural intensification through the mixed farming model. As a local phenomenon there may be important qualities associated with entrustment, so it may not necessarily be classified as part of an impoverishment, marginalisation, or prolétarisation of the pastoralist, although this is of course not confined to absentee ownership systems.

Entrustment may take the form of long-term arrangements which last for several years or even over several generations. Such arrangements can be found when the farmer and the herder have a stable relationship e.g. the pastoralist has lived a settled life close to the farming society for many years. Animals, and especially cattle, represent a very high value for the farmer, and he therefore has to have full confidence in the pastoralist before he will dare entrust his wealth to him.[30]
During the rainy season, the pastoralist may have to take the animals far away from the owners' village which makes control difficult. Long-standing and good relations between the farmer and the pastoralist thus become crucial for the entrustment system. This implies the sédentarisation of the pastoralist as 1) his family often has to stay behind as a guarantee, and 2) confidential relations can only be established after he has lived with the farmers for several years. This is the most common form of entrustment found in the study area.

Short-term contracts cover just a season or a year and the pastoralist may be a stranger or relatively new to the farming society, hence the animals are likely to be kept close to the owners household so that he may keep an eye on them. Such arrangements are common in the subhumid areas to where a number of pastoralists migrated after the droughts of the 1970's and 80's who use other pastoralists without personal herds to take care of their animals (Bassett, 1994b). Cases have also been found of the children of farmers in Nigeria being employed by the pastoralist to herd the animals, though this practice is apparently diminishing with increasing school attendance by farmers' children (Waters-Bayer and Bayer, 1994b:223).
Entrusting also takes place among pastoralists in order to spread the risk of disease and losses due to drought and theft and to help assist a destitute pastoralist, though this practice is rare in the study area.

The pastoralist takes care of the animals of the farmer, leading them away from the fields during the rainy season, and in return he receives the milk from the cows. Occasionally, if the

[30] The value of an average cow may easily represent 1/3 of the total value of agricultural production - own data, see also Table 6 and Table 7 page 113.

owner of the animals is pleased with the work of the pastoralist, he may be given a calf that helps him reconstitute his personal herd (Bayer and Waters-Bayer, 1994:66; Faure, 1990). Some proprietors also cover medical and clothing expenses for the pastoralist and his family, and support the household with millet in addition to their own harvest (Faure, 1990:336; Toulmin, 1992:9; McMillan *et al,* 1993:89). Furthermore, the pastoralist may be given a part of the profit from selling an animal, which is often done by the pastoralist. However, for the pastoralist it is the milk that is the most important incentive (own data) and the benefit of entrustment is thus associated with economies of scale as herding many animals may allow the pastoralist to make a living solely from the animals (Delgado, 1979a:314).

The benefits of entrustment for the farmer can be summarised as follows (McMillan *et al.*, 1993:89-90):

- More efficient use of family labour
- Reduced risk of theft
- Better care of the livestock
- Reduced likelihood of conflicts over damaged crops when the animals are taken away

The main benefits for the farmer of keeping animals are, as mentioned before, manure, animal traction and economic profit. Manure and traction have been discussed under the section on mixed farming but economic profit may be at least as important, if not more. The net profit related to having animals may typically be 20% per year, a figure used by C. Delgado in an extensive study in the Tenkodogo region around 20km from the present study area (Delgado, 1979a: 314). This study, undertaken in 1976-77, used detailed economic modelling to investigate the benefits for the farmer of keeping animals on-farm as compared to entrusting them to the pastoralist (Delgado, 1978; Delgado, 1979b; Delgado, 1979a). Because of the obvious relevance of these findings to the present study, the following section will summarise the major points from this study and the assumptions applied.

Opportunity costs become central in this analysis because they integrate the lifestyle of the individual or the individual household into the economic calculation. In this way, the different preferences, experience and possibilities that distinguish the pastoralist from the farmer are validated by the expression of how the individual could have used his resources alternatively. As each individual has different preferences etc., the opportunity cost of a certain operation is not the same for the farmer as for the pastoralist. This definition does not entirely correspond to a narrow sense of opportunity cost, but here the following definition will be used (Delgado, 1989:351):

> *"Strictly speaking, the opportunity costs of resources are the highest returns that these resources could secure in any use, given the absence of factor market or output price distortions. However, such distortions abound in most of Africa, and Burkina Faso is no exception. . . . As a practical matter, what follows concerns opportunity costs seen through the eyes of the farmer, or what the farmer could have made from the most profitable use of resources. This simplification is somewhat justified by its usefulness in matters of technology adoption. Furthermore, farmer's perceptions of factor opportunity costs are not limited to agricultural options. "*

The finding of most significance for the present study was that entrustment is the economically most feasible way animal husbandry can be incorporated into the Bisa/Mossi fanning system. The internal rate of return (IRR) defined as a function of acquisition cost, the annual return in the form of milk, manure and off-spring, the survival probability and the sales value *but not* the opportunity costs was shown to be higher for cattle kept on-farm than for animals entrusted (12% higher for a female and 6% higher for a male) (Delgado, 1979a: 172). However, when the opportunity costs in the form of labour needed for maintenance of the animals were included in the computation, the IRR for female cattle was the same whether the animal was held on-farm or entrusted and 11% higher for male cattle entrusted compared to being kept on-farm (see table below).

	Male IRR	Female IRR
On-farm without opportunity costs	25%	33%
On-farm with opportunity costs	8%	21%
Entrusted	19%	21%

Table 3 Internal rate of return (IRR) for cattle in Tenkodogo (Delgado, 1979a: 174)

This was based on the assumption that 5 heads of cattle require the fulltime work of one adult male during the rainy season, which equals four fifths of a hectare cultivated corresponding to 800 kg of grain lost due to cattle herding.

The difference between male and female cattle originate from the contribution of milk when animals are kept on-farm. This, together with the manure, is a loss to the farmer when the animals are entrusted, though some of the manure may be preserved through grazing of the farmer's crop residue in his fields. Value of the animals and the offspring does not affect the choice of management system unless the entrusting also implies better herding i.e. better pastures and disease treatment which may lower calf mortality and raise the general condition of the animals hence increasing their value. The cost of entrusting was not included in the calculations but must be assumed to have little influence, as the remuneration is quite modest.

Other benefits of the entrusting not included in these figures are that the farmer avoids conflicts with his neighbours over damaged crops due to stray animals and he also avoids paying compensation in case of damage as this is the burden of the herder. Furthermore, he stands a

better chance of hiding his actual wealth by entrusting, which may be important in a society where sharing wealth with your relatives is an obligation.

It was discussed in the previous chapter that animal traction may not be associated with the profitability required by the farmer before making such investments. In Delgado's calculations, above, the benefits of animals traction were not included. However, when animal traction is introduced into the model it shows that it has, under the most favourable conditions, only very little influence on the result. If, furthermore, the costs of the equipment and the risk associated with the introduction of a new technology are included, it is likely that animal traction will be a losing proposition (Delgado, 1979a:297).

The profitability of animal traction is related to the farmer's desire to be self-sufficient in grain. The more the farmer wishes to be self-sufficient, the less profitable is animal traction as higher returns from cash-crops are required to compensate the costs. It is questionable how suited the soils in the present study region are for cash cropping, and animal traction may therefore not be that attractive for the farmer. However, it must be noted that animal traction today is rather widespread in the present study area, which could be explained by widespread entrustment and an increased value of the animals hence higher profitability of animal husbandry in general.[31]

The overall conclusion of the Delgado study was that entrustment is the most economically feasible way for the fanner to keep cattle and that without entrustment the opportunity costs related to the labour that has to be invested in herding especially during peak periods of labour demand in farming are likely to be prohibitive.

Like all economic models, the one described above rests on a set of assumptions, some more critical than others. Delgado (1979a:306) mentions 6 assumptions that are determining for the validity of the study:

1) The presence of the entrustment system
2) Relatively high population density (40 pers./km^2 in this case)
3) Absence of a viable forage crop
4) Absence of an abundant supply of feed supplements
5) Absence of manpower-supply during peak periods or absence of labour-saving technology
6) Soils and tenure arrangements (location and size of fields) unfavourable to animal traction

To which degree these assumptions are valid in other regions remains of course questionable, though Delgado in general finds the study province to be representative of the West African

Sudano-Savannah, except for a slightly higher population density (Delgado, 1979a:24). However, for the purpose of the present study, their present-day validity will be further examined in the section describing the present-day general conditions in the study area (page 121).

The system of entrustment resting on complementary links between farmers and pastoralists could almost be characterised as a symbiotic relationship (Bruijn and Dijk, 1992:46) and may in some respects also be that. However, the term is avoided here as it has overly-positive connotations which could conceal the disadvantages and frictions associated with the entrustment system. Entrustment may not be popular with the pastoralist, but is often done as a last resort (Dijk, 1994:105). When pastoralists increasingly take up crop farming partly as a result of their loss of animals resulting in a significant sédentarisation of especially the Sahelian pastoralists, the complementary links that may exist are gradually turned into competition (Toulmin, 1983). However, in the study area the pastoralists have been sedentary and were crop farming long before the droughts hit, yet they still primarily see themselves as specialised pastoralists rather than farmers and will normally prefer animal husbandry to crop farming.

However, the pastoralist will only prefer animal husbandry and entrustment on reasonable terms. The remuneration the pastoralist receives for his services is by many seen as unsatisfactory (own data) and may have been worsened due to the droughts that have forced more pastoralists to take entrusted animals, thus increasing the supply of herders in relation to demand which is reflected in lower "prices" (Bayer and Waters-Bayer, 1994:66; Dijk, 1994:105). The practice of paying with a live calf is likewise disappearing, hence the pastoralist is losing an opportunity to reconstitute his own herd (Bayer and Waters-Bayer, 1994:66; Thébaud, 1988:97; Dijk, 1994:105; Own data). In this way, milk, which is the property of the herder, becomes more important and this may lead to more intensive milking leaving less milk for the calves which may eventually lead to higher calf mortality in an entrusted herd (Bayer and Waters-Bayer, 1994:66; Bayer and waters-Bayer, 1992:5; Thébaud, 1988:97). There may also be a tendency for a larger number of the entrusted animals to be males in which the herder has only limited interest as they yield no milk (Thébaud, 1988:97; Own data). The owner, however, may prefer males for speculative reasons or because he uses them as draught animals.

The mobility of the herds may be limited as the owner will often be reluctant to send the animals on distant transhumance where control over the animals is more difficult to achieve (Bayer and Waters-Bayer, 1994:66; Toulmin, 1992:9; Dijk, 1994:105; Own data). This will lead to less efficient herding and thus harm the condition of the animals, and it may also increase the risk of crop damage as the animals will have to stay closer to a densely-cultivated area. This may also increase the pressure on the available rangeland in the proximity of the village with the accompanying risk of rangeland degradation (Toulmin, 1992:9; Thébaud,

[31] The increased value of cattle will be further discussed in a subsequent section (page 123)

1988:97). This factor, however, may be more pronounced in the Sahelian than in the Soudanian zone, as herd mobility in the latter, as will also be demonstrated with the cases from the study area, covers much smaller distances.
Less efficient herding may also arise as the pastoralist may be less inclined to invest a great deal of labour and thought into the management of a herd that he does not own, which may also lead to increased frequency of conflicts due to damaged crops and cattle deaths.

Entrustment may also have a limiting effect on the introduction of animal traction, as animals kept in entrustment often are taken on transhumance by the herder two months prior to the onset of the rains, which is the period when the need for animal traction commences. This is also the period in which it would be most difficult for the farmer to maintain the animals himself (Delgado and Mclntire, 1982:188). However, the farmer can choose to keep his draught oxen at the farm and let the rest go on transhumance, but this of course would impose extra labour on the farmer for maintenance of the animals.

Although, as mentioned by McMillan (1993:89-90) (page 66), entrustment may reduce theft, the increased value of the cattle may also be tempting for the herder, which is why some local farmers think that the risk of theft has increased with the increased value of animals in spite of entrustment. Often, the farmers will speak of the changed mentality among the young pastoralists who are seen as being more aggressive and untrustworthy. Examples of young pastoralists running off with the entrusted animals and selling them on distant markets, all add up to heavy precaution on the part of the farmers. The pastoralists also talk about this change in mentality hence, to the degree that it is real, this may be due to increased competition over resources and the resulting conflicts (own data).

As mentioned at the beginning of this section, entrustment in general has augmented with the change of ownership of animals. As also discussed, there is a marked difference between entrustment in the form of absentee ownership and entrustment that builds on complementarity in a local land use system. The increase in entrustment is mostly related to absentee ownership, while there are indications that the tendency towards agricultural expansion is not conducive to the survival of the local complementary entrustment system. In the present study area there is a tendency towards decline which has also been documented on the Mossi Plateau in central Burkina Faso (Reardon *et al,* 1988:1072).
Entrustment builds on trust, but competition over resources and conflicts ignited by crop damage lead to animosities and the breakdown of trust. Agricultural expansion, therefore, may have directly negative effects on the possibilities for entrustment. As has been shown, entrustment is crucial for the introduction of animals into the farming system, be it for traction, manure, saving, or as a profitable investment. A breakdown of the entrustment system may make further agricultural intensification less feasible, or at best more dependent on external assistance. Thus, the expansion paradox may arise when agricultural expansion, which accord-

ing to Boserup is an integrated part of the intensification process, instead of acting as a forerunner for intensification in fact leads to a breakdown of the entrustment system that is important for the farmers' possibilities for intensifying their land use through the introduction of animal traction. It is because of the expansion paradox that it becomes necessary to maintain a distinction between expansion and intensification, as expansion may have a negative impact on the intensification process when more than one land use system depends on the same resources, especially when these land use systems are implemented by distinct socio-cultural or socio-economic groups.

Besides, the regions that primarily are discussed here may not be suitable for intensive agriculture, but may have a higher economic potential for cattle breeding. If the feasibility of animal husbandry for the farmer, who represents the vast majority in these areas, is aggravated through a breakdown of the entrustment system, this may result in Burkina Faso squandering a large economic potential, as animal husbandry is one of the few activities for which she has an important comparative advantage.

Entrustment may therefore be an alternative to mixed farming in the sense that the integration of animal husbandry on farms may be far from feasible. However, as a means of promoting interaction between animal husbandry and farming, entrustment may be seen as a precondition for the mixed farming system, in the sense that it allows the farmer to introduce animal traction into his farming system, and also creates improved possibilities for manure contracts with the pastoralist. Thus, the two main incentives for mixed farming, animal traction and manure supply, are fulfilled through interaction rather than integration.

4. Summary

Entrustment arrangements can take many forms and must be distinguished from the kind of contract herding where non-local, often urban-based people own the animals, and local systems building on interaction between farmers and herders. In a local land use system, entrustment may exploit the possibilities for complementarity that exist between farmers and pastoralists. It should thus not just be seen as the last forced option of distressed herders. Several forms of entrustment exist but in the study area the most common form is based on long-term contracts or agreements and builds on personal trust often established through life-long acquaintance. The study of Delgado from the 1970's demonstrated the importance that entrustment has for the economic feasibility of keeping animal husbandry for the farmer. Without entrustment, the opportunity costs related to the labour required for the management of the animals would be likely to be prohibitive, thus making it difficult for the farmer to introduce animal traction into his crop farming.

The major problems of the entrustment system are restrictions that the pastoralists may have to accept. Often, the pastoralist is not free to go on transhumance without the consent of the

owner and the remuneration of the herder is by many seen as unsatisfactory which may lead to less than optimal herd management and a diminished sense of responsibility.

Through the entrustment system, the mixed farming model becomes feasible for the farmer, albeit more as interaction with animal husbandry than as an actual integration. One major restriction on this process is the ongoing agricultural expansion that, owing to frequent crop damage caused by stray animals under the care of the pastoralist, leads to many minor conflicts that gradually undermine the good relationship between farmer and pastoralist and thereby also the trust that is necessary for entrustment to function. Thus, expansion may lead to a gradual breakdown of the entrustment system. If entrustment is no longer an option for the farmer, it will be more difficult for him to introduce animal traction in his crop farming. As animal traction is one of the central issues in agricultural intensification through the mixed farming model, expansion in reality may work against intensification. Thus, the expansion paradox evolves and hence the need to operate with a distinction between expansion and intensification, especially when more than one land use system are dependent on the same resources and are being performed by distinct socio-cultural or socio-economic groups.

D. Narratives in development research

The field of development research is evolving continuously. Old ideas are being discarded and new ones take over. Much knowledge has been accumulated about the development of agricultural systems and their interaction with natural resources. Some of this knowledge, however, has been based on data of dubious quality or has been simplified through the mass-media or used politically so that their reliability may be questioned. Recently, quite a lot of attention has been given to the reliability of older findings or perceptions, and terms like narratives, myths, and received wisdom are often used in connection with the debate on environmental research. Narratives have often taken the form of a dichotomy:

> *"Environment and development discourse is replete with examples, frequently taking the form of "bad"/"good" dichotomies: "tragedy of the commons" versus common property resource management; farmers' ignorance versus "indigenous technical knowledge"; Malthusian degradation versus Boserupian intensification, and so on." (Leach and Mearns, 1996a:8)*

Not only narratives but also counter-narratives, that will be discussed in the following sections, enter this dichotomy. The present study is concerned with the dichotomy of the Neo-Malthusian scenario and the Boserupian interpretation of the development of agricultural systems. However, while I tend to agree with Boserup's criticism of the Malthusian paradigm, I also show with the present case that reality lies somewhere in between. There are certain preconditions that must be present for autonomous intensification to take place and there exists a paradox in relation to agricultural expansion which works against autonomous intensification. On the other hand, this does not mean that the system will degrade along Malthusian lines, but

rather indicates something about the applicability of Boserup's theories and points to where development assistance should be channelled. The present study thus enters the realm of narratives and it would not be complete without taking into consideration some of the consequences of this debate. The following section therefore first outlines some of the more general arguments and consequences of the narratives debate, and thereafter briefly examines a few issues that are seen as relevant for the present study. Those are the desertification and new ecology theory, the tragedy of the commons, and the contested irrationality of the pastoralist, often referred to as the cattle complex.

Let me start out by making it clear that 1) the narratives debate is an important contribution to our understanding of the interrelations between society and the environment but that 2) the new findings are not intended for, and should not lead to, ignoring that there are serious environment problems in Africa 3) this study does not see puncturing myths as a goal in itself and is therefore not specifically concerned with this and that 4) there are serious problems related to this debate which may have unforeseen and probably unintended consequences.

I will briefly elaborate on these points, but start with a short introduction to the narratives debate.

The debate typically focuses on what is termed a mainstream view. A mainstream view is a set of ideas that are taken more or less for granted and which implicitly influence the results of other researchers by strongly biasing their objectivity. The researcher is under the influence of perceived wisdom and therefore tends to find confirmations of what is already expected. This influence can undoubtedly be very strong and often works unconsciously, which is why it can be difficult to recognise. The perceived wisdom may, however, also be used deliberately by researchers, organisations or policy workers who may be financially or otherwise dependent on a certain perception of a problem. A typical example is an NGO that is financially dependent on public concern and goodwill and therefore may have an incentive to overemphasise a problem. It could also be a researcher who may be tempted to exaggerate a problem in order to facilitate fundraising for research, or it may be the policy maker who may find a justification in these ideas for imposing restrictions etc. that otherwise would have been seen as harassment or exploitation. The received wisdom originating from a mainstream view can eventually develop into a narrative or a myth, an explanatory causation so strongly embedded in our perception of right and wrong that it is beyond questioning. The word narrative implies for some a degree of myth but can be seen as more programmatic than myth because it has the purpose of getting the hearer of the narrative to do something. Leach and Mearns (1996b) explain the character of the narrative as follows:

> *By making "stabilizing" assumptions to facilitate decision-making, narratives serve to standardize, package and label environmental problems so that they appear to be universally applicable and to justify equally standardized, off-the-shelf- solutions.*

The narrative typically takes the form of exaggeration of some element in relation to another thereby disturbing the original argument and making it readily available for political discourse. The origin of a narrative could typically be mainstream research based on replicated figures and facts that, if the source is scrutinised, may be uncertain; or uncritical extrapolation of data spatially or temporally. Other methodological flaws are disregard of historical data, snap-shot methods, and interpreting short-run observations as long-run trends and thereby ignoring possible cyclical fluctuations.

One example of what can be meant by the mainstream view concerning degradation can be found in a recent World Bank publication *"Reversing the Spiral. The population, agriculture and environment nexus in sub-Saharan Africa"* by Cleaver and Schreiber 1994. Here, a rather pessimistic scenario for the development of Sub-Saharan Africa is presented and supported by various studies and data, often from FAO, World Resources Institute etc. Soil erosion and deforestation are described as some of the very serious problems facing Africa and this is supported by various sources. However, at the same time as these data are being quoted and used as the foundation for the conclusions, a small box put beside the text and otherwise not included in the analyses, informs the reader that estimates on soil erosion are especially difficult to make and that large uncertainties are related hereto (Cleaver and Schreiber, 1994:21-22). One of the studies quoted where soil erosion was estimated from height of trees has recently been revised by the author as possibly grossly exaggerated (Stocking, 1996:148). Like this, a simplified narrative can develop as the original precautions taken by the researcher are omitted in later references or popular versions used by various interest organisations or the media. Another example is provided by Sandford (1983:15) in connection with the 1977 UN Conference on Desertification where the field data from one of the country cases was used to conclude that significant desertification was taken place although the researchers in the draft report did not say this was the case.

A good example of research that led to revision of some commonly-held environmental causations was a study by Fairhead and Leach (1996) in the Kissidougou Savannah area in Guinea. In this area, small patches of forests were found around scattered villages in a savannah landscape otherwise poor in forests. It was the general perception among researchers, aid-organisations, international environmental NGO's, and the state authorities in Guinea that these forests were the remains of a former much larger forest cover and that this deforestation was purely anthropogenic. However, through archival studies, interviews with old villagers, and comparison of old aerial photos with satellite imagery, the researchers found that forest cover had actually increased during the last hundred years and that the forests in the area were actively maintained by the villagers. The forests served several purposes which included protection against bush fires, protection against high winds and excessive heat, they were a convenient source of forest products, they gave suitable microclimatic conditions for tree crops, they had historically served as reinforced fortifications, and they had religious ritual purposes.

The study was able to reveal some misperceptions of environmental causalities which was partly based on research suffering from some of the above-mentioned flaws.
There are several other good examples of research critical of narratives (Leach and Mearns, 1996b; Behnke *et al*, 1993; Tiffen *et al*, 1994; Fairhead and Leach, 1998; Hoben, 1998; Mortimore, 1998; Binns, 1995).

However, often in the narrative debate it is more the policy oriented simplifications that are attacked and not necessarily the original research findings. The insight provided by new findings and the well-founded criticism of various narratives must not be misused to create awareness that the focus on environmental degradation was entirely based on false premises. Just because certain scientific findings, more or less well documented, have been widely misused in a political agenda and hence entered a new discourse for which they originally were not meant, does not mean that some of the basic findings were necessarily wrong. There is a risk that the debate on narratives merely results in a new dichotomy instead of leading to a well justified assessment of how narratives and simplifications could be avoided and the complexity also taken into consideration.

Since the emergence of the debate on narratives in development research, it has become rather fashionable to trumpet the failures of previous research; "to puncture myths". This is especially the case of research using e.g. carrying capacity in the study of the dynamics of degradation of natural resources. Though recent thinking puts emphasis on some positive dynamics that before may not have been given enough attention, it does not mean that degradation of resources does not occur, that locally-concentrated erosion e.g. around villages, in rangelands or of key resources is not a serious problem though it may not be interpreted as part of a desertification process. It could look as if a new mainstream view is developing that is over-pessimistic with regard to older research, especially when it is connected to official organs like the World Bank or FAO, and over-optimistic with regard to indigenous capacity. The problem with such a new tendency is that it can be a pure subjective evaluation that leads to older studies being labelled "mainstream" or "narrative". The new insight provided should not be used as a club with which to hit the heads of former researchers with the possibility of neglecting degradation problems that may be there in spite of the new belief in the resilience of natural resources. Sometimes one is left with the impression that labelling a point of view as old mainstream or a narrative, essentially has the purpose of distancing new findings from older ideas only to make the former appear more interesting, a "demonisation" of older studies.

The entrustment system that is treated in detail in the present study has also been labelled a narrative in the way that the breakdown of the entrustment system could be seen at odds with the historical symbiosis between farmers and pastoralists. It has been maintained that the past has been pictured as a system in harmony and that conflicts in this system are a new phenomenon. Following such a postulate, it is maintained that conflicts are far from new phe-

nomena and that the situation may not be very different from what it has always been; in fact that conflicts are not any more prevalent now than what they have always been (Breusers and Nederlof, 1998). Sources can probably be dug up that would portray the past as a harmonious symbiosis, but several sources can also be found that claim that conflicts have always been there. Therefore, we are left with a subjective evaluation as to whether this is a narrative or a "mainstream" view or not. It is difficult to discern exactly when an idea becomes a narrative or a mainstream view, and in this specific case sources for both points of view can be found. Announcing this as a mainstream and narrative is therefore not necessarily justified, and may thus just constitute a simple demonisation of former studies; an unfortunate result of the quest for puncturing myths (Oksen, 2000).

The process of simplification in relation to narratives is probably the most worrying because it omits the reservations and the precautions that are a natural part of good research. A previous section discussed how the Machakos study in Kenya (Tiffen *et ai,* 1994) has reinforced the ideas of Boserup as a contrasting scenario to Neo-Malthusianism as another myth or narrative. However, there is a danger that the findings of the Machakos study, through simplification, also develop into a narrative. If the preconditions discussed in a previous chapter (page 43) are disregarded, this may lead to another simplified causation, a kind of counter-narrative. Such a counter-narrative could, in this case, be a new wave of optimism ignoring environmental problems, as it now has been shown that environmental problems will solve themselves as long as more people leads to less erosion.[32]

There is no doubt that most of the criticism that has been raised through the debate on narratives is a valuable and welcome revision of old simplifications and bad research. The new insight gives a new point of departure for making better policies and hence better management. There is, however, also the danger that it will evolve into new simplifications ready to be misused by interest groups and the mass media. This new simplification is what I understand by counter-narratives, as they are still narratives devoid of the diversity, complexity and uncertainty that will necessarily underpin good scientific research.

The perception of the counter-narrative differs somewhat among the scientists in the front-line of creating it. In relation to the desertification narrative, Swift (1996:90) seems to think that a new counter-narrative is scientifically sounder than its predecessor as it is based on newer findings and on previous mistakes and therefore is expected to give better results:

[32] "More people - less erosion" is the title of the book published about the Machakos study. A real "ear-catching" title which is all too suited to popular simplifications.

> *"This counter-narrative combines ideas about indigenous technical knowledge and customary institutions, including common property management rules; it points to recent studies showing the high productivity of extensive nomadic pastoralism, and the excellent adaptations farmers and herders in the drylands have made to the vagaries of dynamic, event-driven ecosystems. Such a counter-narrative is a much more accurate and useful construct about what is happening in the drylands than the desertification narrative, and deserves to replace it. There are indeed many signs that this counter-narrative is taking over in the aid bureaucracies, although it has not yet got far with governments. " (Swift, 1996:90) (footnote omitted)*

However, as it still is a narrative it implies some degree of simplification, which points to that Swift uses a more broad definition of narratives. Leach and Mearns (1996a:33), on the other hand, are more in favour of taking in the entire diversity of the issues in question rather than simplifying them. Simplifications are useful, some may even say necessary in policy work and in mass media, hence:

> *"The challenge is thus to create equally compelling counter-narratives which better fit the claims of a different set of stakeholders; preferably, counter-narratives with equally attractive slogans and labels. "(Leach and Mearns, 1996a:33; citing Roe, 1991; Roe, 1995)*

However, as they have no justification in scientific work it may be argued that they should be avoided altogether. Leach and Mearns (1996a:33) consequently take the standpoint that this simplification is not even justified in policy work, and demand that the policy process and its institutions have to change in order to deal with the complexities of science and the real word. I agree with this point but find it hard to believe that a counter-narrative will not develop. In fact, I think it already has. The specific danger of this counter-narrative is that it risks reinforcing the worldwide preoccupation with letting the "invisible hand" of market-forces take control, which could all too easily serve as an argument for not interfering or cutting down on development aid. An example of this was discussed above with reference to the Machakos study to which Rocheleau made the following remarks:

> *"..their story has acquired the power of compelling narrative that supports current and emerging policy in powerful places. The "Machakos success " has been embraced and universalized not only by opponents of Malthusian population politics and theories, but also by proponents of structural adjustment and free market approaches to environmental development policy and by apologists for the state's retreat from public services and environmental protection. This story resonates with these agendas because it suggests that rural farmers can "take care of business " and develop commercially and ecologically viable production systems on their own, if only the markets, a few key technological innovations, and the inputs are there. " (Rocheleau, 1995:5)*

Using a new counter-narrative, this view has received a research-based argument. This is not a standpoint that I see justified by the critique of development narratives as such. The old narra-

tives caused serious misunderstandings and an enormous waste of money and energy on the wrong remedies, and they have directly reinforced the misfortune of specific groups like the pastoralists who have been partly blamed for causing desertification. A critical review of the old "truths", the received wisdom, the narratives and the reason why they could become so persuasive and influential is an obligation of the research community that should always be welcomed. In the critique of the narratives there is no reason to neglect environmental problems that are still there.

> *"..an interest in understanding the received narrative about desertification does not imply a belief that there is no problem of land degradation in the drylands. " (Swift, 1996:85)*

However, as more and more take on the counter-narratives, we risk ending up with a new simplification, with equally dangerous consequences. Where before at least the narratives led to action, this time the counter-narrative may lead to withdrawal which I find even more disturbing.

As the present study hopefully will also demonstrate, abolishing planning and intervention will not necessarily lead to better land use, neither from a social, environmental nor economical point of view.

In the following, a few narratives of specific relevance to the present study will be discussed.

1. Desertification and the new ecology

The desertification narrative and the ensuing debate has much influence on the perception of land use and environment interaction in the Sahel. Although the present study area is situated in the Soudanian zone, basic ideas from this discussion are also relevant for this zone as the land use systems are in many ways related.

Especially since the droughts at the beginning of the 1970's and 80's, much attention has been focused on the gradual degradation of natural resources and the process of desertification with a geographical focus on the Sahelian countries (Niger, Burkina Faso, Mali, Senegal etc). In the media, desertification was trumpeted as an irreversible process illustrated with pictures of dunes steadily rolling southwards and burying fields and villages standing in their way. The pace of this process was calculated and transformed into around 60 football fields per minute being transformed into desert (Benjaminsen, 1998:231).

The desertification narrative originated in the 1930's when Stebbing, a British forester, travelled through the British and French colonies in West Africa and interpreted his observations of the vegetation as a result of human mismanagement leading to desiccation and the advancement of the Sahara (Swift, 1996:74). Most of his findings were refuted by the Anglo-French Forestry Commission a few years later and the debate was more muted during the generally wet years of the 1950's and 60's. After the drought in the early 1970's, the desertification narrative was revived by, among others, Lamprey who, in 1975, was commissioned by

the Sudanese Government, UNESCO, and UNEP to examine the extent of desertification in North-Western Sudan. Flying over the Sahel he compared observations from a botanical survey from 1958 and came to the conclusion that Sahara had moved 90-100 km southwards in this time span corresponding to 5-6 km per year (Swift, 1996:78). However, what he did was to compare the relatively wet years of the 1950's to a period of exceptional dry years and it was therefore not surprising that he found large differences. The desertification narrative was formally confirmed at the 1977 UN Conference on Desertification (UNCOD) where the disastrous consequences of desertification worldwide were spelled out, though based on data of dubious quality and without sufficient regard to the scepticism expressed by several contemporary dryland scientists (Swift, 1996:81). The results from the conference were subsequently frequently cited by various agencies and reports, including the report from the Brundtland Commission. During the 1990's, severe criticism of the desertification narrative gained influence. Very active in this process was a group of geographers at Lund University who, through detailed studies based on remote sensing, field observations and available statistics, showed that from 1980 till 1990 the desert limit was swinging north and south according to rainfall (Helldén, 1991).

As one of the main activities in the areas allegedly menaced by desertification was pastoralism, overgrazing and human mismanagement was often blamed for being one of the causes of the desertification, supported by a number of other narratives like the tragedy of the commons and the cattle complex that will be briefly discussed later (Sandford, 1983:12).

A new view on the ecological mechanisms and especially the ecological resilience of the natural vegetation developed partly in reaction to the desertification narrative.

Traditionally, natural ecosystems were regarded as being in a stable state or equilibrium. The foundation for these views was the theory of plant succession and climax vegetation which developed early in the 20th century. Here, vegetation was seen as responding to soil and climate by establishing a single persistent and characteristic composition, a climax vegetation. When the climax vegetation is disturbed by e.g. intensive grazing it will regress into subclimax vegetation, eventually returning to climax vegetation through a predictable sequence of intermediate vegetational stages (Behnke and Scoones, 1993:3). This will take place through *"competitive interactions and the slow, equilibria! fine-tuning of Darwinian natural selection"* (Ellis *et al,* 1993:32). This view was dominant in range management until the 1970's when papers emerged that emphasised the importance of external disturbances in determining the vegetation. Here, the semi-arid eco-systems were regarded as being so often under disturbance by a variable climate that they would never reach climax vegetation, but instead resilience to external perturbation is seen as a crucial characteristic.[33] This was especially relevant

[33] This idea is, however, not confined to the arid environments as man's intervention, natural disturbances like fire, wind, animals etc. would prevent an ecosystem from ever reaching a stable equilibrium in any place. The ecosystem should rather be imagined as patchwork of ages of recovery from localised disturbances.

for the arid Sahel as it would shed new light on desertification and pastoralism. In the Sahel, rainfall is so variable that grazing pressure is constantly being regulated by water availability so that the natural re-vegetation or resilience of the vegetation is strong enough to overcome the damage caused by grazing. Therefore, to the degree that it occurs, degradation is more likely to be a result of a variable climate than of human influence and is not an irreversible process, as the resilience of the vegetation will help it re-establish itself under more favourable climatic conditions. The system can, as such, be said to be in a state of non-equilibrium.

However, the relevance of these ideas is not the same for the entire Soudano-Sahelian region. Areas in non-equilibrium are characterised by minimal rainfall and very high inter-annual fluctuations. The limits for equilibrium and non-equilibrium environments, though volatile and not easily determined, may be put as low as 400-500mm isohyets, as the coefficient of inter-annual rainfall variation (CV) of more than 30% isohyet closely follows this amount of rainfall[34] (Ellis *et ai,* 1993:33; Coppock, 1993:59; Sumberg, 1994:9). The implication of this is that it only applies to arid environments in the Sahelian zone and therefore is not relevant for the semi-arid and sub-humid areas where 55% of all cattle in Africa resides (Sumberg, 1994:9). In these areas, more equilibrium-like conditions prevail where biomass production is more predictable and grazing pressure is not regulated by rainfall to the same degree, with the implication that the resilience of the environment may not be sufficient to counteract damage. Therefore, attention should be paid to the possible degradation due to overgrazing in these environments, and the new emphasis on the natural resilience of the environment should not be taken for granted under wetter conditions. As the present study area falls well outside the rainfall regime typical of non-equilibrium environments, it has less relevance (see page 105 for precipitation data and CV calculation). However, as ideas on carrying capacity and grazing strategies have been revised considerably partly due to these new findings, and as they are relevant for the present study area, they will be treated here.

Carrying capacity is closely related to the equilibrium paradigm. Basically, carrying capacity is a straightforward measure of how large a population can be sustained by a given area of land. It was introduced in relation to range management in 1906 and has since been applied to a wide range of environments (Bartels *et al.,* 1993:90). In some stable and hence predictable environments, carrying capacity based on biomass production calculations and the nutritional needs of cattle may yield a useful indication of possible stocking densities. Carrying capacity calculations rest on the assumption that *"a unique population of livestock is directly associated with a defined grazing area for a specific period of time"* (Bartels *et al,* 1993:98). It

[34] CV is an integrated measure of the magnitude and frequency of departures of annual rainfall from the long-term mean. Areas of more than 600mm/year may also have a CV greater than 30% depending on the variation and may as such also be characterised as non-equilibrium environments if the 30% CV limit is used (Ellis, 1994:46).

should not be seen as a static measure but may change over time as degradation may lower carrying capacity while technology or improvements to the resource base may increase it. However, when climatic variability, temporal dimension, multiple uses and users, and resource-feedback interaction[35] are added, the complexity of carrying capacity increases.

Carrying capacity has been widely used as an argument against pastoralism in semi-arid and arid environments as it was believed that overstocking was a major driving force behind desertification. However, following the introduction of the idea of non-equilibrium, carrying capacity has been criticised for not being relevant in semi-arid and especially arid environments. There are several arguments behind this. The non-equilibrium state of the environment in some semi-arid and arid areas makes any prediction of annual biomass production unreliable, and even long-term estimates are problematic due to possible decade-long fluctuation patterns in rainfall. Also, the range management system prevailing in semi-arid environments in itself renders the use of carrying capacity difficult as the assumptions behind the calculations are not met. Resources in a common property or open access tenure regime do not have "a unique population of livestock" as the users of the resources are often diverse and manifold. The areas used for grazing under opportunistic herd management are not well defined, meaning that an eventual carrying capacity calculation should be composed of a calculation of the carrying capacity of each individual grazing resource (Leeuw and Tothill, 1993:87) which in reality is difficult as the grazing pattern is by nature unpredictable. Also, in more stable environments where the non-equilibrium paradigm does not apply, herding will often be opportunistic and dependent on access to fallow fields, uncultivated land and crop residue. Hence, the principal limiting factor may not be the potential rangeland biomass production of a certain resource, but rather access to a wide range of resources other than rangeland (Barteis *et al*, 1993:98; Leeuw and Tothill, 1993:87) as is also the case for the present study area. The entrustment system further adds to the complexity of the carrying capacity calculation as the cattle of the sedentary farmers enter the opportunistic grazing management with the implications mentioned above. Thus, though carrying capacity is meaningful in a stable environment under a fixed grazing management e.g. private farmland, it will seldom give reliable results in arid, semi-arid or sub-humid African environments.

Non-equilibrium theories also have implications for the types of herd management practiced. In general, a conservative grazing strategy is aimed at keeping stocking rates constant and low in relation to the available grazing resources in order to prevent serious shortcomings and range degradation in low-rainfall years. An opportunistic grazing strategy constantly seeks to adjust to actual grazing possibilities by adjusting the herd size, dividing it into smaller herds and embarking on long-distance transhumance (Bassett, 1994b: 149; Sandford, 1983:38).

[35] The negative effect the use of the resource may have on its productive potential e.g. degradation due to overgrazing

However, in the Soudano-Sahelian region to which the study area belongs, rainfall is not a limiting factor to the same degree that it is in the Sahelian zone. Rainfall is more abundant and less erratic, hence other factors as well as rainfall will determine the grazing strategy. As these zones are more densely cultivated, one of the most important limiting factors is the availability of non-cultivated land, especially during the rainy season in order to avoid crop damage by the animals, and access to crop residue during the dry season. The grazing strategy is therefore in principle opportunistic as the herder employs a high degree of flexibility and mobility, but for other reasons than those described for the non-equilibrium environment.

Further south in the Guinean zone, the Fulani also employ an opportunistic and mobile grazing strategy. As the cropping season becomes longer the further south one moves, the danger of crop damage by stray animals also increases. This, combined with severe limitations caused by the main diseases, notably trypanosomiasis, makes mobility a very important factor in the opportunistic grazing pattern. The high degree of cultivation and subsequent risk of crop damage has led to serious violent conflicts between farmers and herders in these zones (Bassett, 1994b: 155-56, 165).

2. Tragedy of the commons

Closely related to the desertification narrative was the perception of pastoralists as over-utilising the land through over-stocking the rangeland that would consequently be put under heavy grazing pressure leading to degeneration of the vegetation and desertification. One of the reasons why pastoralists were allegedly overgrazing the rangelands was that these lands were not under private property, but could be seen as a non-regulated open access resource where no one was responsible for the condition of the land and everybody would try to maximise their personal utility without consideration of contemporary or future users. This idea was formulated by Garrett Hardin in 1968 and gained immense influence as it so well supported Malthusian ideas and the general fear of the limits to growth in industrialised society because the scarcity of the resources was beginning to show (Benjaminsen, 1998:218). The article should however, like the works of Malthus mentioned on page 22, be seen in the historical context in which it was conceived. Ross (1998:76) argues convincingly that it was

> *"..merely a clever defence of private property and an argument against the 'welfare state', phrased in terms of the environmental and demographic concerns of the world in which it was published."*

and that it was embedded in the cold war rhetoric of anti-communism that would prefer to see private property and competition as the basic foundations for society and not a tenure arrangement like the commons. It may therefore be interpreted as much as a political statement expressing the concerns of a specific period as a contribution to improving the understanding of natural resource management.

Hardin's article was not based on empirical findings but was a pure thought experiment and has been heavily contested ever since for not making a distinction between land under common property where communication between users and enforced rules exists, and truly open access land where no rules exist and the land may be freely used by everybody (Birgegaard, 1993:27). Hardin was later forced to concede that the commons was a hypothetical model dealing with unmanaged land under conditions of scarcity (Ross, 1998:75) and a pertinent question then would be where such conditions would be likely to prevail. The rangelands that the pastoralists supposedly overused leading to desertification were seldom under a true open access regime as various institutions had specific rights to the land and exploitation was taking place in accordance with certain rules (Birgegaard, 1993:27).
However, it cannot be completely ruled out that degradation occurs due to a lack of management in rangelands, and a higher degree of distant ownership of the herds may lead to less care taken by the herder to preserve resources. On the other hand, private property and rangeland management following a ranch model would not allow for the high degree of mobility and flexibility required for an opportunistic grazing strategy in the Sahelian rangelands. It is also doubtful whether private ownership would be better at controlling livestock numbers or that it would be accompanied by increased resource productivity (Sandford, 1983:136; Birgegaard, 1993:27).

The "tragedy of the commons" narrative was not the only explanation given for the alleged overstocking in the Sahel. The apparent irrationality of the pastoralists was also blamed. This irrationality was in general termed the "cattle complex" and will be dealt with next as it also has some relevance for the pastoralist living in the present study area.

3. *The Cattle complex*

The "East African Cattle Complex" first presented by Herskovits in 1926 has come to signify a certain irrationality of the pastoralist with the consequence that he would tend to accumulate animals beyond what can be seen as economically rational. This included keeping grown out male cattle and old, unproductive cows in the herd instead of selling them, and was explained by a strong cultural affinity with cattle and a desire to have a herd as large as possible as a sign of social prestige. The pastoralist was, in this way, attributed an economic irrationality which could explain the lack of market involvement and the stocking of animals beyond what the environment could sustain, with degradation as a consequence. Though cultural values regarding animals are strong in many pastoralist societies, later studies have questioned this irrationality. Riesman (1990:329) describes for the Fulbe how the sale of animals is associated with shame as cattle is regarded as the foundation of the future livelihood security of the family which is why selling puts the wellfare of the pastoralist and his family at risk (equivalent to the farmer selling his land), and Grayzel (1990:47) describes from Mali how the Fulbe value cattle not as an end but rather as the key to everything. Thus, the behavior of the

pastoralist is quite rational from the point of view of livelihood security, risk aversion, and social value. Furthermore it has been noted that, contrary to later interpretations, the original meaning of the word complex as used by Herskowits was not the psychiatric notion of something being emotionally abnormal but rather as an instrument to describe the cultures of the people in East Africa as consisting of interconnected or interwoven, hence complex parts (Juul, 1999:35).

That pastoralists may not always respond to higher cattle prices with augmented sales may therefore be explained not so much by a special affiliation for having many animals but rather by several other factors (Sandford, 1983:201). This depends on whether the response to e.g. higher prices on animals is seen as a short-term or a long-term phenomenon, the situation of the specific pastoralist and the supply of consumer goods. It is fundamental for an understanding of the pastoralists' behaviour to understand that his capital, the animals, is not only a productive asset from which he derives a living e.g. through milk, but also the foundation for his future capital through his off spring. He will, therefore, have to carefully evaluate his situation and must take into consideration the condition of his animals, the present and future needs of his family and variability in the available resources. What then determines what he may see as a surplus that can be sold on a favourable market will be highly dependent on his specific situation and need. A pastoralist with a small herd will be likely to follow an accumulation strategy while a pastoralist with many animals may consider selling off in order to cash in on high prices. However, this desire of the rich pastoralist will also depend on his ability to manage a large herd, and on whether consumer goods are available to him. Many pastoralists live in isolated areas, and desirable consumer goods may therefore not be readily available. Furthermore, a variable climate and hence variable fodder resources will also influence his choice of whether to sell or not (Sandford, 1983:202). Therefore, the economic behaviour of the pastoralist is influenced by many factors that make his responsiveness to prices unpredictable but based on equally rational choices as other economic groups. Though the influence of a cultural preference for cattle accumulation cannot and should not be ruled out, the unpredictable economic behaviour of the pastoralist may also be explained along strictly economic rational lines.
This discussion will be further elaborated in connection with the findings from the present study area and the issue will be raised concerning whether a more consumer-oriented mentality is emerging among the young pastoralists (page 171).

4. Summary

The preceding pages have shown how the debate on population and environment in Africa has been and is under the influence of various agendas and more or less well-founded opposing views. Some of these ideas, like the non-equilibrium view on ecology, have gained significant importance and although not directly applicable to the present study area must be included as

they add an important perspective on the situation of the pastoralists. Furthermore, its popularity demands a scrutiny of its validity. The "tragedy of the commons" and the "cattle complex" demonstrate the need to not blindly accept received wisdom but instead to strive at being as objective and open as possible when interpreting data. However, it should also be acknowledged that much of the basis for the narratives might stem from the careless replication of findings and not from the original findings themselves. The present study discusses the dichotomy between narrative and counter-narrative and may, as such, help to underscore that there are still environmental and natural resource management problems in Africa that need attention and that the new narratives should not be accepted as a mere substitute for the old received wisdom, leading to new simplified counter-narratives with the inherent risk of encouraging non-intervention and blind confidence in market forces.

V. Fieldwork description and methods applied

The planning and execution of the fieldwork was the result of the continual adaptation of the initial plan to accommodate practical and other constraints, and to include the insights gained before and during the fieldwork. The final outcome differed considerably from the original plans, but the following description of the fieldwork procedure is based on what was actually done. Changes to original plans are not included. The chapter contains an outline of the fieldwork procedure, the standard methods used, how they were applied, and the problems I experienced applying these methods.

The fieldwork was carried out over two stays in Burkina Faso. The first was in autumn 1995 and consisted of *\Vi* months preliminary investigation to assess the feasibility of the original research ideas. The study area was identified and contacts were established with various relevant parties. The second and major stay was in autumn/winter 1996-97 and lasted around 5 months. During this period, I stayed in Tenkodogo in the study province with occasional visits to the capital Ouagadougou, mainly for practical purposes. Though this would have been desirable, I did not live in the villages studied but visited them almost daily. My former experience from Niger had proven to me the value of staying for a prolonged period in the villages enjoying the tranquillity of village life, and especially benefiting from informal evening discussions, but for practical reasons this was not done in this study. My main interest was in the pastoralists living in the area, and as their villages or hamlets are small and based on single family households scattered over a large area, it would not have been possible to find accommodation without inflicting a considerable burden on the household, a situation I definitely wanted to avoid. It would have been feasible to stay in the farming villages, where it would have been easier to locate vacant huts, but because of the often difficult relationship between farmers and pastoralist I did not wish to signal a close relationship to one group over the other. I therefore opted to base the fieldwork on daily visits, with the consequent limitations. I did, however, have assistants staying in the farmer villages for some weeks during the application of the questionnaire survey, which I explained to the pastoralists as a merely practical arrangement given that respondents often had to be interviewed in the evenings.
The winter season was chosen for the fieldwork, as the respondents would have more time available for the interviews and as the pastoralists during this period are normally close to the villages with their herds, making it a lot easier to locate them and establish contact.

The field-work was composed roughly of four components, some of which overlapped in time:

1) Identification of the study area
2) Questionnaire survey with farmers and introductory interviews with pastoralists
3) Detailed interviews with selected respondents
4) Interviews with various key informants and gathering of secondary data

A. Identification of the study area

The study area was identified in cooperation with SEREIN.[36] Under the SEREIN research program, a multidisciplinary team of researchers have been active in the northern Seno and Oudalan provinces and in Boulgou in the south. After having visited the SEREIN provinces, I understood that animal husbandry in the southern part of Burkina Faso has gained considerable importance, and that the Boulgou province offered good opportunities to study interaction between farmers and pastoralists in an environment dominated by agricultural activities. The region has, furthermore, been the object of far less research interest than the Sahelian parts of the country, yet a few older studies provided valuable background information and insight into the situation around 20 years ago. The presence of SEREIN had obvious advantages, as other researchers and students were active in the region, thus providing the opportunity to draw on and exchange results in a multidisciplinary team. Furthermore, my affiliation to the SEREIN program had obvious practical advantages, as I was lucky to be able to use contacts and accommodation established, for which I am very thankful.

Once the region was selected, I visited a number of villages spread over the region in order to get an impression of the animal husbandry and farming activities, hi eight of the villages visited I held informal talks with village representatives present and soon learned that the Sanogo and Lergo villages offered a good local context for my investigations. This was based on the following factors:

- the villages are located in an area where pastures for the animals are still available
- the pastoralists live in the area and have many links with the farming communities
- the entrustment system is in use
- animal husbandry is widespread
- agricultural expansion is ongoing
- conflicts and competition over resources are present
- the proximity to Lake Bagré opens up for important future aspects of the development potential of the province
- the two villages are different with respect to cultivation density and animal husbandry, yet they are close neighbours with many interrelations

[36] Sudan-Sahel Environmental Research Initiative

It is difficult to be conclusive concerning the representativity of the villages for the region or for the West African Savannah. The majority of agriculture in the region takes place in more densely-cultivated areas than the one chosen for study, while the animal husbandry and especially the pastoralists are primarily found in the less densely-cultivated regions of which the present study area is typical. The farmer villages chosen are dominated by the Bisa ethnic group, who are not the majority in the province but who nevertheless make up a significant part of the population (around 30%). Agricultural practices do not differ substantially between the Bisa and the dominating population group, the Mossi, and the Bisa villages are therefore regarded as representative of agricultural activities in the less densely-cultivated parts of the region. The pastoralists' situation is, to a large degree, determined by agricultural expansion, which is common all over the province, and their situation is therefore assumed to be relatively typical for the province.

B. Comparative research

As mentioned previously, one of the reasons for working with two village communities was to study the effects of agricultural expansion on animal husbandry and possibly reveal a development trend in the region. This was done through the use of comparative research. Comparative research is, generally speaking, comparable to natural science in the sense that both try to study a phenomenon by comparing the object of study with other similar objects, but under varying conditions. However, compared to the natural sciences it is much harder to control the "experiment" in social sciences as variables cannot just be excluded or included as in a laboratory test. Rather, the social scientist has to work with a given reality, and hence the only possibility of controlling the independent variables is usually through careful research design and selection of objects to be compared. More specifically, this means that I have to make sure that the villages I wish to compare with the aim of revealing a development process are comparable. Comparable in this respect signifies that I must try to hold as many independent variables as possible constant, that is identical is both cases, so that I may isolate the dependent variables I am interested in studying, though a division of this type of variables into dependent and independent may be ambiguous and simplistic. Independent variables in this case could be: bio-physical environment, culture or ethnicity, level of wealth, access to other resources etc., while the dependent variables I wish to study are: agricultural expansion, settlement and herd management patterns of the Fulani, and the use of animal husbandry in the farming systems. What I basically aimed to do was to control the "background variables" (Holt and Turner, 1970:8).

Comparative studies are very common in social science and often cover very different entities. Comparison across cultures, countries and even continents is not rare, though it may be questioned how it is possible with acceptable certainty to exclude the influence of variables that cannot possibly be held constant over such spatial, cultural, and socio-economic distances. I am in the present study much less ambitious when it comes to comparative research, in that I

will not try to make comparisons over large distances or across cultures. Rather, I have the specific purpose of studying the influence of agricultural expansion on the animal husbandry of the Fulani, and thereby also the consequences this may have for the animal husbandry of the fanners. Agricultural expansion is one of the activities where the two villages differ, and as it is also an activity that shows a historical evolution the results from this comparison may also reveal a trend or a development process.

In order to hold as many independent variables constant as possible, I have chosen two adjacent villages, situated only a few kilometres apart, with the same ethnic composition. By doing so, I believe I have been able to hold most of the independent variables reasonably constant, which will be apparent in the description of the villages in the two subsequent chapters. These variables concern the character and quality of the natural resources, access to markets and technology, access to possibilities for off-farm activities, cultural values, and socio-economic characteristics e.g. wealth, development assistance, and extension coverage. However, there are also issues for which it is difficult to ascertain whether the two villages are comparable. One is the political influence the villages may have which may affect the livelihood possibilities of the villagers and hence their land use. Political power can be very personal, and it cannot be excluded that one village may be more favoured because of personal connections and influence. However, from observations in the villages during my work there, I have not identified any salient feature in one over the other. Thus, even though uncertainties will always be present in comparative research, I have tried to limit this by holding as many variables as possible constant by careful choice of the research sites. Considering the entities over which comparative research is often conducted, I feel pretty confident that if comparative research is at all possible, which I think few would question, then my study area should offer almost ideal conditions.

C. Sampling

When working in a village which is too large for all households to be covered, it becomes necessary to make a sample. In the research, two basic models were used in making a sample. With the two large farmer villages, a systematic random sampling was carried out as a high degree of representativity was desired. This was done by compiling a complete list of all households in the villages and then picking every second one on the list for interviewing. Like this, any possible ranking that the list may present i.e. older and most important households at the top, divided into quarters etc. was eliminated. If a household thus chosen was not available for interviewing, the household adjacent on the list was chosen. Like this, a representative sample was obtained.

When working with the pastoralists, however, the small number of households allowed for all to be covered in the initial background interviews. The households selected for in-depth studies were chosen according to the principle of extreme cases. Working with cases has advan-

tages and drawbacks, and in the following the principles and my application of the case method will be briefly outlined. This will also explain the selection of this methodology.

D. The case method

How does one describe some of the more general principles that make up the foundation of a complicated system, e.g. the African pastoralists' behaviour? This problem has been touched upon before. According to Socrates and later on Plato, universal knowledge and absolute truth should exist, but as Socrates spent his days wandering about in the Athens streets asking for it, he only found specific examples describing universal knowledge, not the knowledge itself (Flyvbjerg, 1989; Flyvbjerg, 1991):

> *"Socrates: ...tell me, what do you say the holy is? And what is the unholy?*
>
> *Euthyphro: Well, I say the holy is just what I am doing now, prosecuting murder and temple theft and everything of the sort-*
>
> *Socrates: Do you recall that I did not ask you to teach me about some one or two of the many things which are holy, but about that characteristic itself by which all holy things are holy ... teach me what this same character is, so that I may look to it and use it as a standard, which, should those things which you or someone else may do be of that sort, I may affirm that they are holy, but should they not be of that sort, deny it. " (The Dialogues of Plato in Flyvbjerg, 1989:4)*

Thus, Socrates had to deal with cases although he was deliberately looking for universal principles. A few cases were necessary as illustrations of a certain principle, a theoretical causality.

My first encounter with Africa consisted of a 3-month stay in a small village in eastern Niger. This village became for me a basic example of farming systems in Africa, and I more or less deliberately make comparisons with this village when working with other similar regions. This village is not representative of the region or of Niger or of West Africa for that matter, but it demonstrated many causalities that are also valid in other regions. Thus, for me, one context-sensitive case became the catalyst for a more general, albeit limited, understanding of a complicated issue. Likewise, a few carefully selected cases may reveal some important embedded mechanisms of the complicated issue of integrated farming systems.

A case may be defined as an example of how things are done. In the context of my research, it could be the practice of a pastoralist or his household, or the village in which he lives, depending on the level of analysis. In fact, all the data that I gathered in the field can be said to be cases. However, what in analytical terms makes a case interesting is when I believe that it provides an illustration of some theoretical or general principle.

The most important characteristic of the case is that it is context-sensitive. It is part of a larger entity, the locality, has been formed by it, and because of the limited number of cases and the way it is chosen it cannot be characterised as representative. Consequently, case studies stand in contrast to the quantitative methods of research often used in association with statistics, where a parent population is described in terms of a representative sample, collected and analysed according to well-defined and commonly acknowledged principles.

The case study as a method is not a new phenomenon. Its division from statistical methods manifested itself during the 1930s. It has provided the foundation for most anthropological and a good deal of sociological theorising, but has been most heatedly debated in anthropological spheres, possibly because quantitative techniques were less important there (Mitchell, 1983).

Cases can be used in various forms and for various purposes. The typical case tries to define a typical object; the critical case is used for falsifications; the extended case follows an object over time or through a series of events; and the extreme case aims to reveal diversity. Only the latter has been used in the present study.

The enumerative induction or quantitative method seeks to avoid biases in the sample. The aim is to define a representative sample that may explain causalities in the parent population. This is often done by means of the random sample. However, random sampling or careful consideration of the representativity of the sample may not be the most appropriate methodology. A random sample will normally yield an impression of the average, while diversity may not be so well described. Therefore, a deliberate choice of extreme cases may reveal more information, thus leading the way to a more thorough theorising (Seur, 1992; Flyvbjerg, 1991).

When choosing the households according to the extreme case method, it is important to consider over which variables variation is sought. Variables used here were: herdsize, degree of entrustment, wealth, grazing pattern, and herd management. Like this, a picture is revealed of *how* and *why* things are done and not so much *how much* they are done.

E. Questionnaire survey with the Bisa farmers

After having conducted introductory interviews with the village representatives and other key informants in the two chosen villages, Sanogo and Lergo, a questionnaire survey for the farmers was designed. The reason for doing this was that it would not be practically possible for me to conduct semi-structured interviews with all the farmers in the two villages. The pastoralists were the main object of study and the information from the farmers would thus be most feasibly collected through a questionnaire survey.

The questionnaire was designed with the aim of revealing the basic characteristics of the farmer households and their relationship to the pastoralists. Several drafts were designed and tested with respondents before a satisfactory form was found. The subjects covered included: the general economic base of the households, agricultural practices with an emphasis on past and present resource use, the purpose and practices of animal husbandry and interaction with the pastoralists.

The survey was applied by two assistants who did not originate form the villages involved, in order to avoid personal biases and relationships. In general, the farmers were forthcoming and welcomed the opportunity to express their views. The assistants lived in the villages during the weeks the survey was being applied and became well integrated in the local society, thus giving me access to their own valuable perception of the validity of the results from the survey. The use of two assistants had the advantage that personal biases were to some degree revealed when comparing the results between them. This was done through a daily debriefing and evaluation of the results, which allowed for ad hoc revisions. The questionnaire is replicated in Appendix 3.

The data from this survey is the main foundation for the analysis of the farming communities. Altogether, 101 interviews were made of which 50 households in Sanogo and 47 in Lergo were included in the analysis. A few were left out because of the poor quality of the data.

These represent almost half of the households in each village and are considered representative as the households were chosen randomly. However, as can be seen from Table 4, not all quarters of the villages have been covered equally. This is especially valid for Sanogo. There may be distinctive socio-economic characteristics for each quarter as demonstrated by the use of distant fields in a study in the Bisa village, Silmiogou, some 25 km north of Sanogo (Reenberg 1997:21). However, in Sanogo the central quarter is by far the largest and comprises the vast majority of Sanogo's inhabitants, which means that the sampling will be representative of this quarter and will therefore probably only result in a minor distortion of the results. The quarters of Sanogo more closely resemble actual villages, hence it is safe to say that the data cover the Sanogo Centre village. For Lergo, sampling more equally covered the quarters. However, some of the more distant quarters were not covered.

Village quarter	Number of respondents	Number of households
Lergo Bougla	21	**41**
Lergo Natenga	17	25
Lergo Padama	g	g
Sanogo Centre	47	101
Sanogo Natenga	2	
Sanogo Zembo	1	

Table 4 Number of Bisa farmer respondents according to village quarters

In the analysis of the fanning communities, all relative figures e.g. percentage of farmers etc., thus refer to the village sample, i.e. neither the individual quarters nor all the farmers in the villages.

F. Semi-structured interviews with selected Fulani respondents

The main part of the primary data originates from semi-structure open-ended interviews with selected pastoralists and a few farmers. Various PRA methods were also used. These methods allowed for an in-depth discussion of issues of specific interest.

The pastoralists live in villages or hamlets close to the fanner villages. All pastoralist households were covered in an introductory interview. The purpose was to get an overview of the pastoralist households and to choose specific households for further in-depth studies. Therefore, the topics covered in the introductory interviews focussed on background information on the household and animal husbandry practices.

The respondents that I wished to follow more closely by using repeated semi-structured interviews were selected according to criteria of variance in herding practices, entrustment and household characteristics. The cooperativeness of the individual respondents was of course also an important factor. The aim was to cover a large variation according to the underlying principle described in the preceding section on case studies. I therefore chose pastoralists who had many animals, few animals, many entrusted, few entrusted, had resettled, had stayed, had children who had resettled with the animals, had changed grazing pattern and had not changed grazing pattern. Like this I sought an insight into the conditions for the pastoralists according to the principle of extreme cases.

The table below summarises the number of interviews executed with the pastoralists. As all households were interviewed at least once the first figure represents the whole population (N). The main issues were: the animal husbandry of the pastoralist, their practices, resource use and the bottlenecks and possible competition or conflict situations.

No. of households	22	11	4	3	1

Table 5 Number of interviews conducted with Fulani households

Qualitative, semi-structured open-ended interviews allow for a high degree of flexibility, and each interview can be adapted to the situation of the individual respondent (Waters-Bayer and Bayer, 1994a). Issues of specific importance can be dealt with in more detail, while others of less relevance can be cut down. The open-ended nature of most questions allowed for discussions, and the interviews were therefore most often informal and had more the character of a

conversation rather than an actual interview. Informality naturally increased with the number of interviews repeated with the same respondent. Repeated interviews allowed for follow-up questions on previously discussed issues and the introduction of new ones. Issues raised by one respondent could subsequently be followed up with other respondents. The use of a relational database helped assure that roughly the same information was gathered from each household (see later). A numbered checklist of questions was used during the interviews that took place in the respondents own household or in his field. A tape recorder was not used during interviews as this is likely to create a distance between interviewer and respondent. Furthermore, note-taking has the advantage that it provides an instant overview of the interview which may be important when referring back to previous statements. Also, the treatment of tape recordings is very time consuming.

For all the interviews an interpreter was used. The role of the interpreter is very important, as he not only has to translate everything, but also has a large responsibility in mediating the exact information, creating a relaxed atmosphere and gaining the confidence of the respondents. Moreover, given the often tedious and repetitive nature of the job, a thorough understanding of and interest in the research issue is required. I was very fortunate with my choice of assistant as he was a Rimaibe Fulani with intimate knowledge of the region, but with no personal ties to the communities studied. I used a male assistant, as the majority of our respondents were males. Many possible errors are associated with the use of an interpreter, but through working closely together during several months, we developed a thorough understanding of the limitations involved and to the best of my knowledge most biases and errors were corrected.

A specific problem arose in connection with questions about the size of the herds. As animals to a large degree are equivalent to wealth, and as in these societies there exists a strong obligation to share wealth with relatives, it was expected that this information would be difficult to obtain. We used various crosschecks both with respect to respondents and methods to verify the information obtained, and the length of the study allowed us in several cases to make confirmations through direct observation. My role as an outsider was also important in this respect as I was seen as fairly harmless. I am fully aware that the information gathered is only accurate to a certain degree, and due consideration has been taken when analysing the data. However, it was not my impression that the number of animals was concealed for me, and most respondents were not reluctant to talk about it. It is doubtful how secret animal numbers are in reality, as the herds can be directly observed in the neighbourhood, and as entrustment arrangements did not seem to be kept secret. People, including the fanners, were generally quite well informed of who entrusted to whom, and often also how many. I am deeply indebted to my assistant for his delicacy in dealing with this matter, his sharp sense for inaccuracies, and his capacity as a vigilant observer.

For these reasons the figures given, to the degree that they are inaccurate, are likely to be under- rather than overestimated. However, though the absolute figures are uncertain there is no reason to believe that the relative figures should not be correct i.e. that the respondents in one village should be more reluctant to give a correct figure than respondents in the other. Besides, the level of the figures obtained corresponds rather well with the ones obtained by Delgado in his study in the region in the 1970's. One specific problem at that time was that the cattle were taxed per head, which gave the respondent another incentive to underestimate the true number of animals. This is no longer the case, hence this source of error is eliminated.

G. Interviews with various key informants and the gathering of secondary data

This component was done simultaneously with the others. Key informants included various members of the local community, whose special situation gave them an insight into specific issues not encountered among the other respondents. Also, various administrative bodies were visited and interviews conducted with extension officers, project personnel and officials both locally and at national level. In relation to this, important secondary data in the form of statistical material, project and other reports, official documents, maps and aerial photos were gathered. Assistants also collected prices on local markets and the Pouytenga animal market was visited.

H. PRA methodology

For some of the information needed a convenient methodological point of departure was participatory rural appraisal (PRA) methods. Though derived from the realm of practically-oriented extension work, this approach has the advantage of being informal and based on the participation and knowledge of the local people, which makes some of the techniques also useful for obtaining information (Chambers, 1994; Waters-Bayer and Bayer, 1994a; HED, 1994; Drinkwater, 1993; Mikkelsen, 1995; Moris and Copestake, 1993).

PRA methods developed from the rapid rural appraisal (RRA) methodology that had its origin in extension work, research, and fact-finding prior to and during development projects.

RRA emerged in the late 1970s, partly as a result of growing critique of the way development was being planned and implemented. Terms like "rural development tourism" evolved, and more attention was given to various biases which outsiders are exposed to. Critique of the process of questionnaire surveys and their results, in addi-

DR	**Direct Ranking**
PMR	**Pairwise Matrix Ranking**
RRA	**Rapid Rural Appraisal**
PRA	**Participatory Rural Appraisal**
PLA	**Participatory Learning and Action**
MARP	**Méthode Accélérée de Recherche Participative**

tion to the need for more cost-effective methods, paved the way for new approaches (Chambers, 1984; Chambers, 1994).

RRA could be seen as a supplement, and in some cases an alternative, to the time-consuming methodologies of questionnaires and farming systems research. With the application of the simple RRA techniques, agricultural surveys, including report writing, could be completed within weeks, whereas a full-scale questionnaire survey would operate with quite different time-scales. However, RRA was basically still operating vis à vis the beneficiaries in terms of informants answering questions put by project personnel, who then evaluated the results (Waters-Bayer and Bayer, 1994a:8).

PRA developed gradually during the 1990s from the experiences gained through the application of RRA methodologies. It became clear that the beneficiaries were quite capable of evaluating their own situation and identifying possible solutions to problems. Thus, though still rapid, PRA sought to involve the beneficiaries more actively in problem identification and solution-finding processes. The aim was to change the role of the outsider from being a development agent who defines and executes certain development activities, to a more facilitating role, where local ideas and priorities are in focus. PRA is, therefore, more a new approach using old techniques than a new methodology as such, or as Robert Chambers (1994:959) puts it:

> *"RRA methods are more verbal, with outsiders more active, while PRA methods are more visual, with local people more active, but the methods are now largely shared. "*

A basic element of the PRA methodology is its innovative character, that is, the tools and methods should be adapted to the specific situation in which the extension personnel/researcher finds himself. They cannot be seen as a fixed catalogue of readily-applicable tools (Mikkelsen, 1995:70). The PRA handbook holds only one sentence: "Use your own best judgement at all times" (Ibid., Robert Chambers at a seminar in Copenhagen 1995).
Common to the PRA methods is that the process of information gathering in itself is very important, as it might reveal differences, perceptions and ideas that would otherwise be very time-consuming, if not impossible, to uncover.

PRA techniques are now spreading from the purely rural and agricultural domains into urban areas with the implication that the prime promoter of the methodology, the RRA Notes series has changed its name to PLA Notes, an acronym for Participatory Learning and Action notes.

Though still basically developed and developing for practical extension work with a dominant focus on Southern Asia, the informal and participatory nature of the methods also makes many

of them suitable for pure information extraction, often the core of scientific research. Though it may be argued that information extraction is not participatory, it should here be understood as the use of methods that involve the local people actively in the process of revealing information and clarifying preferences.

Resource mapping and transect walks were used in the reconnaissance of the local environment and the resources available to the population. Progeny history or "interviewing the cow" was used to reveal the herd management and dynamics. It consisted in having the respondent explain the complete life history of a specific cow, which gave me an impression of the main problems related to herd management, diseases present, calving rates etc. (Armbruster and Bayer, 1992). The results from this method can be found on page 169.
Trees and bushes were identified in the field with the help of the invaluable handbook "Trees and shrubs of the Sahel"(Maydell, 1990). Grasses are more difficult to identify especially as the fieldwork was carried out during the dry season where most grasses are dry and without flowers. However, by comparing the local Fulani and Mossi names with literature lists it has been possible to identify most of the grasses concerned. In identifying varying grasses and trees I am indebted to botanist Jens Madsen from the SEREIN program.

Rankings were used on several occasions as a means to reveal the often subtle preferences of the respondent. This concerned primarily the preferences for various fodder resources. My experience from using these methods in both Niger and Burkina Faso may, I believe, have some general relevance. The following section will discuss direct ranking (DR) and pairwise matrix ranking (PMR) with respect to ranking cattle fodder preferences and tree utilisation. I experienced certain difficulties with both methods but also some advantages of the one over the other.

1. Description of the ranking methods

Direct ranking (DR) is a simple method of obtaining a preference ranking and at the same time facilitating a vivid discussion. It is a very common PRA method and many variants exist. What is considered here to be the key difference from the pairwise matrix ranking (PMR) is that the respondent or participant will rank several objects simultaneously. PMR only requires evaluation of two objects at the time. DR can also be adapted to function more or less as a pairwise evaluation, but here a more original form of DR is considered. The DR applied here was made very simple and with the use of locally available materials like beans, herbs, stones etc. in order to emphasise the informal character of the evaluation. Besides, local materials demand minimal preparation allowing for the quick application of a ranking when a suitable issue emerges during discussions or interviews, or just when the time feels right.

The objects that were to be ranked were marked on the ground with either a paper label or a symbol, or written directly on the ground. Holes were made besides each object and a certain number of beans were given to the respondent, who then was asked to divide the beans between the objects according to preferences in relation to a single given criterion. In this case it was the value of the fodder species for cattle in a specific season, and in another example the availability of the fodder species in the season. I found the simplicity and applicability of this method very appealing, and it also facilitated the active participation of the respondent in choosing the objects to be ranked.
This method could also be termed direct scoring with a single criterion. However, the method was used for obtaining a ranking (defining the rank of the objects but without assessment of the relative importance of the individual rankings) rather than a scoring (distribution of a number of items according to the relative importance of the objects), which is why I have chosen the term direct ranking. The distribution of the beans serves as a visual aid to the respondent in contemplating preferences, something that becomes increasingly difficult with a larger number of objects.

The DR or scoring is often seen performed with the construction of a matrix with several criteria on one axis and the objects on the other in which the beans are distributed accordingly. However, I found this method even more complex than the method applied here, and did not work further with it. In relation to this method is often seen an adding-up of the preferences given across criteria in order to obtain an overall ranking. This may give misleading results, however, as the criteria are not likely to be equally important. If a ranking rather than a scoring is performed, a further problem is added because the spacing between the ranks is unknown. Such an adding-up would only be possible if the spacing from one rank to the next was identical or known, and the criteria equally important or weighted.[37]

As mentioned, **pairwise matrix ranking (PMR)** works with the respondent making a definite choice between only two objects.
A matrix is drawn on paper for each criterion e.g. the availability of fodder species in the dry season (see Figure 2). All objects are listed against one another in a triangular matrix, and each object is tested against the others. For instance, for each fodder species it is asked whether A is better than B, A better than C, ..D etc.; whether B is better than C, ..D and so forth. The answers are noted in the matrix with a number or another symbol representing each choice, they are counted and a ranking obtained. The questions can go much further than a simple evaluation and include pros and cons for various uses or characteristics, but this may limit the number of objects that can be ranked in a session.

[37] See Maxwell and Bart (1995) for a more thorough discussion of this problem.

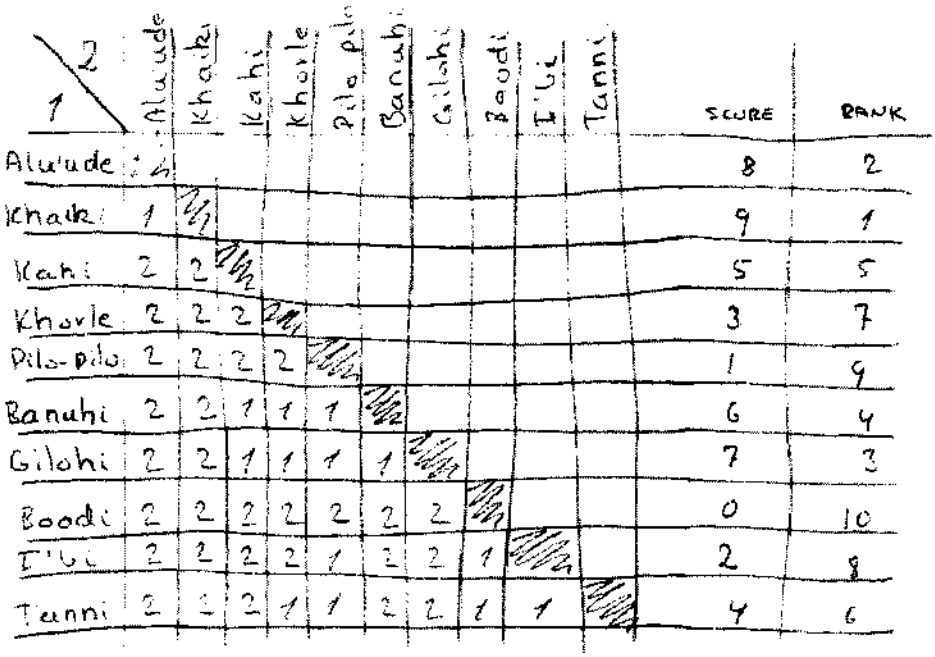

Figure 2 PMR of general preference of common trees and bushes used for cattle fodder with Fulani respondent. This case shows no inconsistencies and no draws were made by the respondent, aswill be discussed later. Note that the other half of the matrix may be re-used for a second ranking with the same objects but other criteria or another respondent.

Cards representing each object can be made and put down two by two when doing the evaluation. However, as this requires that the respondent can read, the usefulness of this method in rural Burkina Faso is severely restricted.[38]

2. Discussion of the field application of the ranking methods

Direct ranking allows for a good discussion concerning the ranking of the objects. However, a common difficulty arises when the respondent is illiterate. How can the ranked objects be marked in an unambiguous manner that does not create confusion? Of course, a good point of departure would be to use the actual herbs or the leaves from the trees. However, this option may require an unfeasible amount of preparation, as the material may not be readily available.

The accuracy of the ranking itself is questionable, as it is difficult to rank e.g. 10 objects, directly against one another. Preferences are not always easily defined, making a realistic ranking of several objects displayed simultaneously very complex. As mentioned, the distribution of beans among the objects serves as a visual aid but does not make the evaluation less complex. To make a choice between only six objects, Robert Chambers (Chambers, 1988:14) used questions like *Which is best? Which is next best? Which is worst? Which is next worst? Ofthe*

[38] See Gordon (1988) for further description of this method.

two remaining, which is better? I find this demonstrates quite well the problems that would arise when ranking a larger number of objects.

An objection to this might be that it is not the accurate ranking in itself that is the primary goal of DR, but rather the discussion that evolves during the process. This may be true, but when working as an outsider with an interpreter it becomes difficult to get the arguments down on paper without interfering too much in the discussions. Simultaneous translation simply is not adequate.

The researcher's influence on the evaluation is another interesting point. As DR is suitable to generate vivid discussion among the participants, it may be difficult not to somehow influence the discussion. This is because the respondents have to understand the principle of distributing the beans according to preference or whatever the focus of the session might be. This sounds simple, but may in fact be rather difficult, maybe not to understand, but to practice. The researcher, who from the emerging results can see that the distribution may not be sufficiently detailed or logical, will probably ask supplementary question like "why do you give more beans to A when you just said that B was better with respect to...", with the possible result that the respondent will get the impression he has made a mistake and quickly correct the ranking accordingly.
It is also quite likely that the initial ranking will show many equals. This may, in fact, reflect reality rather well, or it may be a result of the difficulty of choosing and distributing the beans. Here again, the researcher may be tempted to encourage the respondent to do a more nuanced ranking, and the respondent will probably adhere to this out of simple courtesy.
The possible outcome in both cases is a misleading distortion of the results.

Though the direct ranking described above may in fact work out in some situations, and will probably be suitable when working with a limited number of objects, I find that PMR gives a more accurate and reliable ranking. The pair-wise matrix ranking works with minimal interference from the researcher, yields reliable results, and requires neither respondent literacy nor special prerequisites.

The most important aspect of PMR is that the respondent only has to consider two objects at a time, a much simpler task than contemplating and sorting out several objects simultaneously. Preferences are often obscure, and making a choice between just two objects may be an important aid. Especially when dealing with many objects against one another this becomes an important issue. The respondent does not see the ranking during the evaluation, but only has to consider two objects against one another. He does not have to worry about whether the ranking is correctly made or whether some of the objects ought to change place. When accumulated, the simple repeated choice between two objects results in a ranking that has not been

disturbed by such considerations and that reflects the immediate preferences of the respondent.

PMR provides a good guarantee of non-interference by the researcher, as he is less likely to influence a respondent's prompt choice between only two variables. The choice of the respondent is normally swift and without hesitation, which also underlines the simplicity of the method. Neither the researcher nor the respondent can see the ranking before the final computation has been made. This means that possible inconsistencies are less likely to be discovered during the evaluation, hence corrections, as discussed under DR, are unlikely to be made at this point. This hinders the discussion, but reduces the risk of interference.

However, nothing is perfect and there are also problems with the PMR.

First, the discussion that may reveal important properties of the objects can be lost. Some discussion may occur and may be recorded, but basically this method is targeted at ranking and not so much at facilitating a discussion. Then again, what would be a more suitable point of departure for a subsequent discussion of the different objects than a relatively accurate and unbiased ranking made by the respondent himself? All sorts of clarifying questions and comments can be dealt with subsequently.

Secondly, many variables against one another is a rather tiresome and trivial process that may soon result in waning interest and repeated and increasingly obvious yawning. Breaks may offer a solution to this problem, and there is no reason why the ranking can not be stopped and continued in another session another day.

Third, the results may not be conclusive. Though, in theory, it should not be possible to obtain two objects with the same ranking, reality shows that this will sometimes occur. However, when two or more objects display the same counts, the solution may be to look at the actual choice the respondent originally made between the two. Should this reveal inconsistencies it could be checked again with the respondent, and may provide a convenient opening for further discussions.

Identical ranking may also indicate that precise ranking simply is not possible between some objects, which of course is perfectly legitimate. The method is based on the respondent making a definite choice between two variables. This will usually not be a problem to him, but in some cases, he may not be able to choose, and insist on a draw. This, of course, has to be accepted by the researcher as a legitimate answer, as forcing a choice may seriously distort the result, but it does constitute a methodological problem. Should this no-choice be counted in the final computation or should it not? Testing the difference between counting and not counting the no-choices did not reveal a clear answer except showing an anticipated and rather good

correlation between the number of no-choices and differences in rank. However, if the no-choices are found primarily among the stronger objects, they may be underestimated if they are not counted. If e.g. the respondent finds it difficult to choose between two strong objects but can easily separate the weaker objects, the two equally strong objects will be one count less than the weak ones. This may distort the result as the strong objects are not counted because they are not preferred, but simply because they are equally strong.
The same argument goes for the weak objects, only in reverse. If two equally weak objects are counted, they will get a higher score and hence a higher ranking. If the majority of no-choices are found among the weak objects, the distortion will be more significant. It is a matter of dominance. If most no-choices are found among the strong objects, they are likely to be underestimated if not counted. If counted, they may be overestimated, but as they are already among the strong objects, this distortion is likely to be less significant.
I therefore think it best to count the no-choices when they are predominantly found among the strong objects, and not count them when the majority of them are found among the weaker objects.

Nevertheless, the uncertainties described may eventually serve as an indication that some objects may not be ranked accurately, and the resulting ranking may therefore be the best and most accurate result obtainable, being indicative rather than absolute.

The two PRA methods of direct ranking (DR) and pairwise matrix ranking (PMR) represent two possible ways of obtaining a ranking of subtle preferences. They both have their strengths and drawbacks, but when it comes to performing simple ranking with a larger number of objects, the DMR is likely to yield the most reliable and unbiased result.

I. The use of relational database in the treatment of qualitative data

During the data collection and analysis, extensive use was made of a relational database (MS Access). Most of the data gathered is of a qualitative nature, but databases, contrary to popular belief, are equally well suited for treating qualitative data as they are for treating quantitative data.
During the fieldwork, the database was used to keep track of the information gathered among the pastoralists. In the evening, the information gathered during the day was written into the database so that by looking up the information for the next day's respondent, a quick overview was gained of the data missing from this specific respondent. During the analysis of the data, the database provided an extremely fast and easy comparison of data. By entering criteria for the information wanted e.g. households from one village with more than 5 members and who had entrusted animals in their herds, their statements on a specific issue could quickly be listed and thereby complicated relationships could be revealed without having to flick through many sheets of paper as would be a typical way of doing it. Thus spontaneous ideas could be

pursued instantly and with relatively little effort. The use of relational databases can therefore strongly be recommended for treatment of a vast amounts of quantitative as well as qualitative data. The only criteria is that the information must be comparable across respondents. All data were typed into the database by myself as this process, though tedious, is important for getting an overview of the material. Furthermore, in this process the data goes through a subjective "filter" for relevance and reliability. This process, I believe, should not be handed over to assistants if at all possible.

J. Aerial photos and satellite images

Aerial photos and satellite images were used only as improved maps. Especially the aerial photos with their superior resolution were valuable for in situ identification of land use. Because of time limitations, classification of land-use types etc. was not performed though this would have been a valuable source of information. A series of aerial photos from 1978 and 1994 was acquired from IGB (Institut Géographiques Burkina Faso). The satellite images (SPOT 1994) were supplied through the SEREIN programme.

VI. The local context - an introduction to the Boulgou Province

The following section describes Boulgou province in which the present study area is located. The chapter has three main purposes: 1) to present background information mostly based on secondary data on the local context of the study as a supplement to the ensuing detailed analyses of the specific study area based on primary data 2) to present an overview of the process of agricultural development in the region and 3) to investigate the role and feasibility of animal husbandry in the region. The data used comes from a wide range of sources including "grey" literature[39] and is of varying quality, hence some of the findings will be treated with appropriate cautiousness.

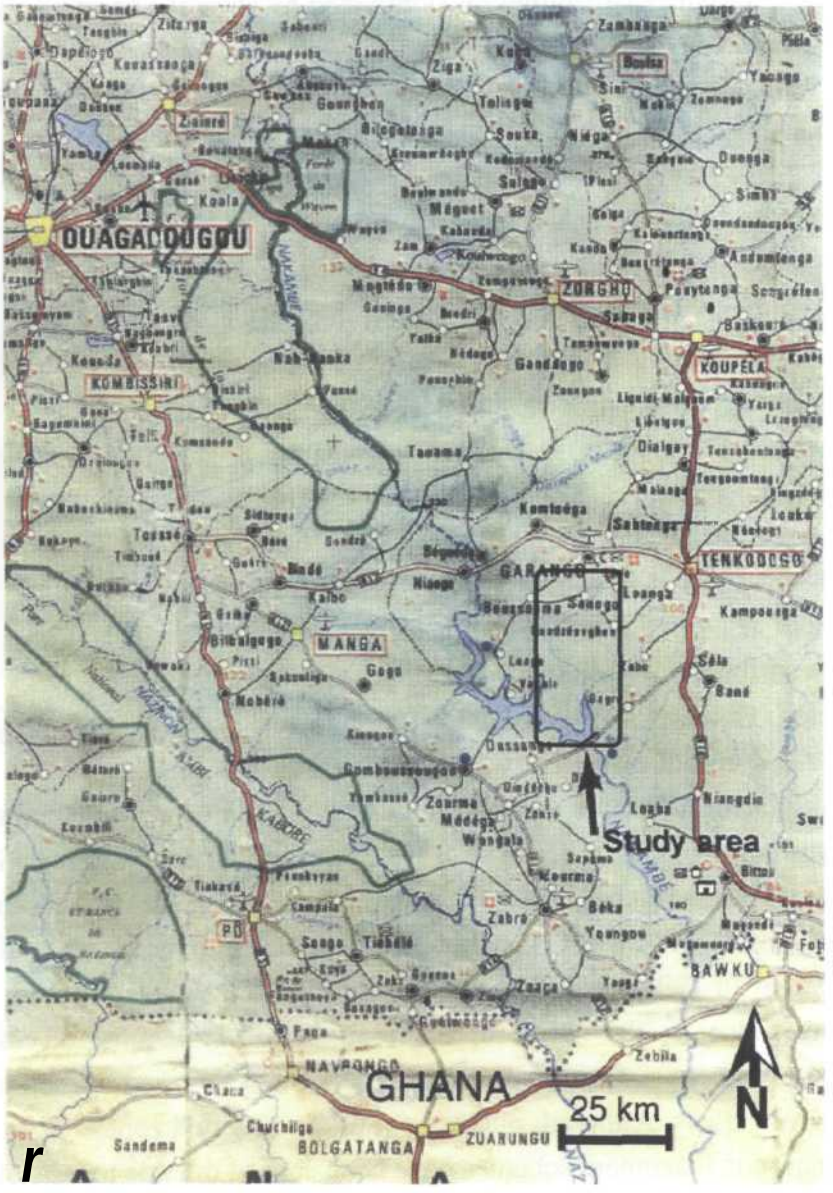

Figure 3 Map of Boulgou province indicating the research area

The Boulgou province is one of the south-eastern provinces of Burkina Faso and shares its borders with Togo and Ghana. This region is characterised by relatively good agro-climatic conditions and higher population densities compared to the northern parts of the country. However, although the southern

[39] Refers to semi-published material typically elaborated by consultants in relation to specific assignments

location is relatively advantageous as will be shown later, it is still a marginal region compared to the large and densely-populated southwestern provinces where the bulk of agricultural development has taken place.

A. Basic characteristics

The province of Boulgou is dominated by several important rivers weaving through the landscape. The Nakambe and Nazinon (Red and White Volta) and the Nouhao feeding into the White Volta are the major rivers, and a number of smaller seasonal feeder rivers make up a network of riverbeds.

The passage of these rivers in the region makes water in the vicinity relatively easily available all year round. The riverbeds, though dry most of the year, often have a shallow water table that can be exploited relatively effortlessly by digging shallow temporary wells. The larger rivers enable the construction of small dams that may hold water during most or all of the dry season allowing the watering of cattle and occasionally irrigation of vegetables or even rice. However, rivers braiding through the area does not mean that water is not a limiting factor. The most populated areas in the region are situated far from the riverbeds, and irrigation and shallow temporary wells are not feasible options. Almost all of the cultivation is exclusively rainfed, and water-availability during the dry season is one of the main problems. A mobile and flexible production asset like cattle, however, will have relatively easy access to water. In 1992, one of the country's largest dams was finished, damming up the White Volta river close to the village of Bagré around 35 km south of Tenkodogo, creating a large-scale reservoir (hereafter referred to as Lake Bagré) shaped into elongated branches by the former river valleys. Although planned to sustain irrigated zones only a fraction of the envisaged irrigation management schemes have been carried out due to lack of funding.

Figure 4 Nouhao River in the early dry season

The southern position of the region results in a relatively high precipitation for Burkina Faso. The average from 1980-1996 is 763mm, and for the period 1922-1996 it is 900mm. During the last 75 years, rainfall has varied between a maximum of 1543mm in 1935 and a minimum of 523mm in 1947. In average there are 51 days with rain in a year (SPRA, 1994). In 1984, when the second recent drought hit Sahel, the region received 533mm as can be observed in Figure 5. Most primary data used in the analysis concerns 1996 which, with 784mm, was close to the recent average. The pattern of declining rainfall during the last 2-3 decades as

observed in most of the Sahel seems to be confirmed in Tenkodogo though the region seems to be less affected due to a generally higher rainfall level. The region belongs to the Soudanian agro-ecological zone normally defined by precipitation levels of between 600 and 1200mm (Mertz and Reenberg, 1999:125). With reference to the discussion on equilibrium and non-equilibrium environments (page 78) it should also be noted that with these levels of rainfall the region cannot be characterised as a typical non-equilibrium environment. The coefficient of interannual rainfall variation (CV) has been calculated at 22,7% for the period 1922-1996 and 16,3% for the period 1980-1996.[40] This positions the present study area well outside the areas characterised as non-equilibrium environments when using the limits of a CV>30% and average rainfall of less than 400-500mm (Ellis, 1994:46; Ellis *et al*, 1993:33; Coppock, 1993:59; Sumberg, 1994).

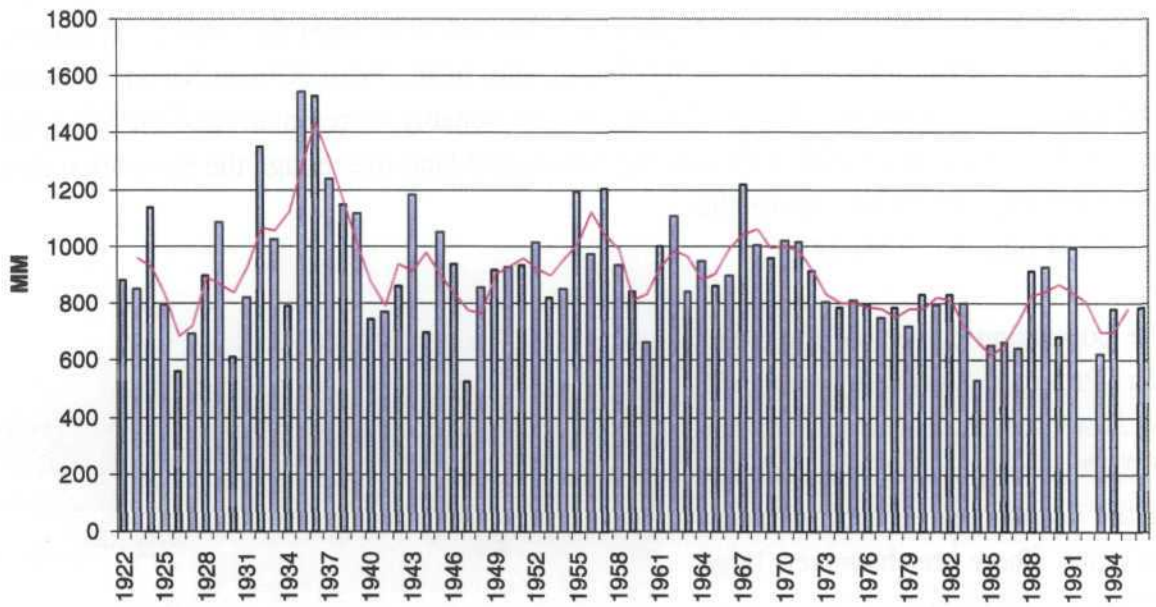

Figure 5 Precipitation Tenkodogo 1922-1996 with 3-year running mean. Source: Burkina Faso Meteorological Institute

Onchocerciasis or riverblindness transmitted by the black-fly (Simulium sp.) that thrives in running water (Pedersen, 1996) made large areas along the riverbeds in the region unsuitable for permanent exploitation until the 1970's, when the impact of the WHO Onchocerciasis Eradication Programme was first felt. Therefore, large areas surrounding some of the river-beds have only recently been exploited for agricultural use (McMillan *et al*, 1993). These areas were formerly only used for dry season grazing by pastoralists primarily based on the Mossi Plateau (Faure, 1990). Though dominated by rapid agricultural expansion, large areas,

[40] Calculated as st.dev./mean*100

especially bordering the rivers, are still densely vegetated and relatively free of cultivation and thus represent a considerable grazing potential.

The soils are generally poor in organic matter, nitrogen and phosphorous, curtailing agricultural potential. The soils are for the most part composed of a ferruginous leached sandy to silty soils, and deeper brown soil with a silty to clay texture. Other less common soils found are hydromorphs and vertisols (Danida, 1995). Many of the agricultural holdings are on soils composed of a thin covering of light sandy material over lateritic crust (Delgado, 1978). The region is generally considered unsuited to moderately suited for agricultural development **(McMillan *et cd.*, 1993).**

The vegetation is bush savannah with interspersed trees. Important tree and grass species are listed in Table 18 and Table 19 in Appendix 2. The relief is rather flat with a few inselbergs breaking the horizon. Though the high heterogeneity of the West African Savannah makes it difficult to talk of representativity, the region is reasonably representative of the West Africa Savannah with respect to soil, climate, vegetation, and land-use though the population density it is probably somewhat above the average (Delgado, 1979a:24).

Figure 6 The Bagré hydroelectric dam

The population density of the Boulgou Province averages about 55 inh./km^2 with an annual growth rate of 2,7% corresponding to a doubling of the population in approximately 26 years. There are, however, large regional differences. The most densely-populated departments are Tenkodogo (99 inh./km$^{2)}$, Garango (138 inh./km^2) and Zabré (71 inh./km^2), and one of the least populated is Niaogho (37 inh./km^2) (calculated from 1993 figures SPRA, 1994:5). In general, the eastern part of the province is relatively sparsely populated while the most densely populated area is found along and north of the Garango-Tenkodogo road. Half of the population is under 15 years of age.

The most important ethnic groups are Bisa (58%), Mossi (30%) and Fulani (8%) (1985 figures Danida, 1995:280). The Mossi are only found in the northern part of the province, while the other two groups are scattered throughout the province. Both among Bisa and Fulani the family is the basic socio-economic unit, normally single families consisting of only husband and wife or wives and children, but occasionally also extended families including brothers, cous-

ins etc. The households are often very large with numerous children, including adopted and other family members' children.

The Bisa and Mossi are sedentary farmers whose households are loosely clustered in villages that may occupy a large zone with fields separating the individual households. The Fulani are sedentary pastoralists who normally live in separate villages. The ethnicity of the household is often instantly recognisable as the Mossi build brick walls *(banco)* between the individual huts, whereas the Bisa only use andropogon or other straw material, while Fulani omit the wall entirely.

B. Agriculture

Crop cultivation is considered the most important activity in the province. It is practiced by almost all of the population and is the most time-, space- and labour-consuming activity undertaken.

It is estimated that around 35% of the total area in Boulgou Province is cultivated, of which 10% is suitable for irrigation. It is further estimated that around 70% of the potential agricultural area is under cultivation (Danida, 1995). Estimates based on classification of satellite images revealed cultivation ratios (cultivated area/total area) varying between 14 and 74%, with the highest densities found around and north of the Garango-Tenkodogo road (Reenberg and Dybkjær, 1996).

Mossi and Bisa farmers are the major cultivators. Most often they possess several manured and well laboured fields close to the village, while the "bush-fields" are holdings often several kilometres from the village. Cultivation in a fallow rational system is not common and the outlying fields are most often cultivated without regular application of manure. The total area cultivated is on average divided into 20 irregularly-shaped plots distributed over an area equivalent to that of a circle with a radius of 3 kilometres with the bush fields at least 5 km from the compound (Delgado, 1978). These figures, however, cover a considerable variation, as the number of fields cultivated in the study area is significantly lower. The cultivation to some degree resembles the "ring management system" system described by Prudencio (1993) for the Mossi Plateau in central Burkina Faso where the intensity of cultivation falls in the form of concentric, von Thiinen-like rings the further one gets from the farm. The Fulani normally maintain only one well-manured and relatively high-yielding field surrounding their hamlet or village. The average area cultivated is around 3.1 ha while the Fulani cultivate around half this area (Danida, 1995). Agricultural expansion towards the north and south of the densely-populated Garango-Tenkodogo road area is considerable, though saturation of land especially north of the road is becoming evident (Mertz and Reenberg, 1999:129). The recently-opened areas following the eradication of onchocerciasis have also initiated a rapid expansion. Expansion in the study area will be dealt with in more detail in the analysis of the primary data.

The cultivation in the area is dominated by subsistence production. The only significant cash-crop cultivated is groundnut which, according to local and not very reliable statistics, makes up almost 30% of the surface cultivated (DSAP - Direction des Statistiques Agro-Pastorales cited in Danida, 1995:149). Other minor cash-crops are cotton, rice, maize, cowpeas, soya, potatoes, woandzou (bambara groundnut), and tomatoes. Major subsistence crops are sorghum, millet and maize, with sorghum and millet taking the lead interchangeably. Often, sorghum is considered the most important crop as it lasts longer in the household since its taste is inferior to that of millet. Two sorghum varieties are cultivated: red and white, the first being the dominant, but both varieties are often interplanted.[41]

Rice is cultivated as dry-rice in the depressions or as wet-rice in association with dams and riverbeds, but is still a minor crop in the region. However, with the expected developments bordering Lake Bagré, rice may well become an important crop in the near future.

Figure 7 White sorghum (Sorghum bicolor (L.) Moench)

Yields are low compared to test results. Data on the local yields are not accurate, but figures from an FAO project formerly present in the region suggest millet yields of around 570 kg/ha and sorghum and maize around 650 kg/ha, while groundnuts yield around 519 kg/ha (Danida, 1995). These yields come to only half of the estimates published by the ministry of agriculture (DSAP cited in Danida, 1995), which might indicate the problem of reliable, accessible statistics.

In general, and in all parts of the region, the harvest does often not suffice for the needs of the household until the next harvest (Ibid.; own data). In May/June, stocks are often depleted, and animals or other assets must be sold if no credit can be obtained. This does not appear to have been a common practice 15-20 years ago (Danida, 1995; Delgado, 1979a), which with some reservations could be taken as a possible sign of degradation of the natural resources or regression in precipitation (Danida, 1995).

The weeding and the harvest are the most labour-intensive parts of the agricultural year. Both weeding and land preparation are normally done with the hoe. Animal traction is rather widespread and according to own data it has been used by up to 55% of the farmers for an average of around 6 years while data from more densely-cultivated areas suggest figures between 64 and 100% (Reenberg, 1997:22). The practice is spreading, which has also had an influence on the price formation of good quality oxen on the markets (own data). The ox-plough is an important instrument in the expansion of cultivated areas as it improves the working productivity

of the farmer. Around 3/4 of ox-plough users in the study area had expanded their fields after beginning to use the plough. Also, the recent introduction of the cart has enabled the farmer to transport the harvest over long distances, thus opening up more distant land to him (Danida, 1995). This has allowed the farmers to exploit land along the shores of Lake Bagre based on seasonal settlement.

Sowing is performed by the whole family, and consists of dropping a few grains in a shallow hole that is subsequently covered with dirt. The crops are often mixed. Millet and white sorghum are planted on the bush fields, while red sorghum and maize are planted on the fields closest to the village. The fields close to the household are manured regularly with household waste and manure from the animals, if available, while the more distant fields are seldom manured. Several sowings may be necessary, depending on the distribution of the rains. Sowing normally takes place May-June.

Weeding is being performed by the adult members of the family. Normally, 2-3 weedings are necessary. The fields closest to the village are the most important, and are consequently weeded more thoroughly. Weeding is a major determinant of the yield. The harvest takes place in October-November. The harvest is stored in granaries inside the courtyard.

Commercial inputs like chemical fertilisers and insecticides are very seldom used due to low availability and elevated prices.

Labour is an important bottleneck in agricultural production, especially during weeding and the harvest. Labour availability may be determining for the acreage cultivated though also access to off-farm capital seems to be an important factor (Mertz and Reenberg, 1999:133). Off-farm income in the form of seasonal or permanent migration, often by younger, male members of the household or local petty trade and occasional jobs, is important.

C. Animal Husbandry

Animal husbandry is considered the second most important activity. According to statistics from the regional veterinary services (SPRA, 1994),[42] the province has a general animal population density well above the national average (3 ha/TLU against 7 ha/TLU national)[43] which, when compared to provincial averages, places it among the most densely animal-populated provinces in the country. In 1995, Boulgou province had the third-highest number of cattle in Burkina Faso, only surpassed by Seno and Gourma provinces, while with respect to sheep the

[41] See Appendix 2 Table 20 for a list of scientific names of crops.

[42] The SPRA figures are based on the 1989 census "Enquete Nationale sur les Effectifs du Cheptel (ENEC) modified with an annual growth rate estimated from trials, comparable agro-ecological regions and expert studies. Annual growth rates are set at 2% for cattle, donkeys, pigs and camels, 3% for sheep, goats and poultry and 1% forhorses (DSAP, 1996:2).

[43] TLU (Tropical Livestock Units) conversion factors: Horse 1; cattle 0,7; sheep 0,12; goat 0,12; donkey 0,53; camel 1,18 (Danida, 1995:200).

province was sixth and for goats sixteenth out of 30 provinces (DSAP, 1996:3). In 1974, however, the region had a cattle density close to the national average (Delgado, 1979b: 19) and though these figures are not directly comparable, an important increase in the cattle population is confirmed by other figures discussed below.

There could be several reasons for this increase. The region has for a long time been an important animal husbandry zone, with the Fulani from the Mossi plateau in the north arriving in the dry season to exploit the grazing resources on the free land along the rivers, which has been deserted due to onchocerciasis (Faure, 1990). During the last two-three decades the region has received a large number of pastoralists migrating from the northern, more densely-populated regions like Namentanga, Kouritenga and Ganzourgou to settle in a more favourable environment made permanently available with the eradication of the onchocerciasis (Delgado, 1979b; Delgado, 1978:3; Faure, 1990; McMillan *et al.*, 1993:90; Danida, 1995:199; UNSO, 1992; Breman, 1992:48).[44] Other reasons for the growth may be sought in the general trends towards agro-pastoralism where farmers increasingly acquire animals to be used for draught, savings, or as an actual economic activity (Speirs and Olsen, 1992; Graaf, 1994; own data). Furthermore, the profitability of animal husbandry has improved as the demand for animals has increased due to increased demand for meat as a result of the rapid urbanisation, and the more prevalent use of draught animals (Danida, 1995). The devaluation has also helped to raise cattle prices as will be discussed further in subsequent sections.

This has, in the second half of the eighties, led to a 70% increase in cattle from 1983-89, indicating an annual cattle growth rate of 11%. Goats had a modest growth rate of 15% during 1983-89, and sheep growth rates seem to have stagnated (Danida, 1995:200). Thus, it seems that the situation in Boulgou is in opposition to the oft-quoted trend that small ruminants make up an increasing part of the livestock. This is often seen as partly resulting from the droughts from which a common restitution model goes through small ruminants that have superior reproduction rates compared to cattle, and partly because the profitability of small ruminants in some cases may be superior to cattle on the assumption that adequate veterinary support is provided (UNSO, 1992).

Since 1989 no census-based statistics on the animal husbandry exist, hence it is impossible to ascertain whether or not this significant growth rate has continued. However, as climatic conditions have not improved significantly during this period (see Figure 5 page 106), the southward move of the herds could be an ongoing process. Although such data should be treated with extreme caution, it does reinforce the impression of a rather massive presence of animal husbandry, and that this is a relatively new phenomenon.

[44] Also according to personal communications with Moumini Savadogo, Antenne Sahelienne, SPS, Ouagadougou.

Figures from the local animal husbandry extension office (SPRA, 1994) show that cattle and sheep make up 37% and 36% respectively of the stock while goats make up around 24% of the total animal population. If, however, the crude number of animals is transformed into tropical livestock units (TLU), cattle will make up around 74% of the total as can be observed in Table 6. When calculated in terms of monetary value, cattle make up around 86% of the total market value of the animal population.[45] Again these figures are only to be considered rough indicators, but they do nevertheless point to the significance of cattle compared to other species.

Specie	Number	Partition numbers	TLU	Partition TLU	Market price	Value (1000 CFA)	Partition total value
Cattle	259,580	37%	181,706	74%	80,000	20,766,400	86%
Sheep	256,100	36%	30,732	12%	6,000	1,536,600	6%
Goats	170,830	24%	20,500	8%	4,500	768,735	3%
Horses	2,600	0%	2,600	1%	80,000	208,000	1%
Donkeys	20,700	3%	10,971	4%	40,000	828,000	3%
Total	709,810	100%	246,509	100%		24,107,735	100%

Table 6 Number and value ofanimals in Boulgou Province. Animal numbers (SPRA, 1994), market prices own data 1996. Prices (and values) are only indicative as they vary considerably with season, market situation, size, age, condition etc. See also footnote 45 page 112.

As cattle dominate heavily with respect to TLU and value, the focus of the present study will be placed here, though the importance of small ruminants for the livelihood of the household and specific members of the household is fully acknowledged. However, the pastoralists in the region are primarily concerned with cattle, and because of this economic importance, it is here that the potential for the region with respect to animal husbandry should be sought.

The high value of animals, especially cattle, may also be illustrated by a simple and rough comparison of the value of an average harvest.

[45] Market prices used are my own data from the local markets during the dry season of 1996 (an average rainfall year). Prices (and values) are only indicative as they vary considerably with season, market situation, size, age, condition etc. The calculation was also done with average national market prices 1994 (Sidwaya, 1994) where the animal prices differed, but the partition of total value gave an almost identical result.

Crop	Harvest(kg)	Market price (100 kg, CFA)	Value (CFA)
Millet	**784**	10.000	78.400
Red Sorghum	377	7000	26.390
White Sorghum	257	9000	23.130
Groundnut	550	10.000	55.500
Cowpea	103	12.000	12.360
Rice	290	10.000	29.000
Total			**224.780**

Table 7 Local market value ofan average Bisafarmer harvest in the study area (own data)

As can be seen from Table 7, the average harvest from a Bisa farmer household is roughly equivalent to a quarter of a million CFA on the local market.[46] Compared to Table 6 it can be seen that this roughly corresponds to three heads of cattle. Thus, the offspring of a modest herd of less than 10 animals should be able to more than outweigh the value of an average harvest. Animal husbandry therefore has a high value compared to crop cultivation, which may further underline its economic potential.
Almost all cattle in the region are Zebu hunchback cattle *(Bos indicus).*

1. Pastures

The significant increase in cattle in a region otherwise relatively densely cultivated and characterised by rapid agricultural expansion is likely to lead to increased competition over access to land. Though various sources mention competition and conflicts between farmers and pastoralists and farmers and farmers (Delgado, 1979a; Danida, 1995; Tarp and Boissezon, 1993; Faho, 1995; Faure, 1990; Lund, 1996) it is difficult to get an overview of their severity in the region. In the analysis of the primary data, the character and the prevalence of farmer-herder conflicts will be further dealt with in a local context which will help to clarify the problem. Here suffice it to say that pastures for grazing of animals especially in the depressions is a problem that needs to be addressed if the animal husbandry potential is to be exploited.

The southward move of cattle means that other types of grazing resources are used. There is an ongoing debate on the advantages and drawbacks related to this change which, among others, involve the quality of the herbs and the availability of alternative fodder resources like crop residue. In the following, some points in relation to this will be made.
When compared to the drier Sahelian parts of the country, the herbs in the Sudanian zone may be of inferior quality due to higher precipitation levels and consequent nutrient dilution (Breman *et al.,* 1996:29; Breman, 1992:42; Leeuw and Tothill, 1993:80; Mclntire *et al.,*

[46] Market prices are from Tenkodogo market dry season, November 1995 (own data) and harvest figures are calculated as average for the Bisa farmers interviewed in the study area 1996 (Figure 25 page 151). Because of

1992:15; Powell and Williams, 1993:26). When growth is not hindered by water availability, nutrients become the limiting factor, thus imposing a nutrient stress on the plants, which may result in poorer herb quality. However, the different sources do not always seem to agree on these points. Breman (1992:42) believes that pasture quality decreases with increasing water availability until a certain point when the potential of the perennial grasses and woody species outweighs the poor quality of the herbs thus resulting in an overall increasing fodder quality when going further south. In earlier works, Breman was of a rather different opinion as he concluded that the north savannah areas produced better pastures, both with respect to quantity and quality, when compared to the northern Sahelian areas (Breman *et al,* 1985:B22). Thus, some uncertainty seems to characterise the discussion, which may be ascribed to the level of generalisation being applied. What should be evident whether or not the overall quality of the fodder resources increases or decreases with the north-south gradient, is that the herbs are available in larger quantities in the south allowing for increased fodder selectivity and decreased mobility which means that the animals do not have to spend the same amount of energy on transhumance, nor do they necessarily lose as much weight during the dry season due to malnutrition or hunger. Whether this is sufficient to outweigh the higher nutritional value of the herbs in the north will depend on the local context.

However, with the increased cultivation density and the more limited availability of natural herbs, crop residue becomes an important fodder resource at the beginning of the dry season after the harvest. The leaves of the millet and sorghum plants are a medium-quality feed compared to natural pasture, while the leaves of beans and groundnuts are of superior quality (Breman *et al,* 1985:B21). As crop residue is available longer into the dry season than natural pasture, the effective availability of fodder is larger with a higher degree of cultivation than with abundant natural pastures[47] (Mclntire *et al,* 1992:36, 43). The high availability of crop residue therefore represents an incentive for animal husbandry, though competition over grazing resources may also affect the availability of crop residue, which will also be dealt with in the analysis of the primary data.

The present study is concerned with the consequences of agricultural expansion for animal husbandry, notably pastoralists. One of the determining factors for the patterns observed is tenure. Tenure is a vast field of study in itself, and it is outside the scope of the present study to go into detail concerning the highly complicated situation prevailing in Burkina Faso. However, below some major issues in the current tenure situation will be outlined in order to provide a background for an understanding of the current situation of the pastoralists in the present study area.

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various uncertainties and the origin of data from two different years they can only serve as a rough indication.

[47] At least until a certain point of intensification.

The tenure situation in the region is characterized by ambiguity. The legislation in relation to land acquisition changed with the revolution in 1983 when all land was declared state property with the RAF-84 (Réorganisation Agraire et Foncière). With the introduction of a democratic constitution in 1991, Blaise Campaoré, who replaced the charismatic leader of the revolution, Thomas Sankara, in the 1987 coup, was elected president and a new RAF-91 was introduced whereby farmers could obtain title deeds through administrative procedures (Lund, 1996:7). However, a dichotomy between state laws and customary rights prevails as an applicant for land now needs the consent not only of the state authorities but also of the customary chief. A recent revision of the laws, the RAF-96, did not change this situation.[48] As the pastoralists, according to customary "laws", are often not entitled to own land, and as pastures used for grazing are not recognized as a justification for acquiring land rights, they will often have difficulties defending pastures and even cultivated fields from agricultural expansion by the sedentary farmers. Also, cattle corridors, which in principle are protected by state laws, cannot in reality be effectively safeguarded against agricultural expansion, as some cases from the region show (Lund, 1996; own data). Thus, access to land is to a high degree dependent on the goodwill of the farming community, which is the customary authority controlling local land tenure. Pastoralists will therefore have to rely on negotiations with the farming community over access to land and can only partially count on support from the state authorities. They therefore become dependent on their own negotiation strength translated into wealth and good relations with the farmers. As good relations with the farmers are difficult to maintain in a densely-cultivated area as will be shown later in the analysis, the pastoralists, and especially the less well-off pastoralists, are likely to come out at a disadvantage, with the likely consequence that they will be forced to move away.

However, this apparent lack of protection of the pastoralists, and thereby the major part of the animal husbandry, does not correspond well with national political ambitions. President Compaoré has defined 6 major domains where national producers should target their efforts. Agropastoral development is second on the list after amelioration of the environment. Animal resources also figure very high in the formulation of the country's industrial (Danida, 1995). Furthermore, animal husbandry is defined as a priority sector in the PASA programme (Programme d'Ajustement du Secteur Agricole) which forms part of the local SAP (Structural Adjustment Programme) financed by the World Bank and others. The integration of animal husbandry and agriculture implying a certain degree of sédentarisation of the pastoralists are considered particularly important directions for development (Danida, 1995). The EU is also actively involved in the development and adjustment of the animal husbandry sector. Hence, the political climate is definitely in favour of animal husbandry and sees it as a major national resource and one of the paths to further development.

[48] Christian Lund pers. comm.

The political initiatives concerning animal husbandry do, among other things, involve the establishment of pastoral zones. Pastoral zones are basically large continuous areas reserved for pasture, and have well-defined and secured tenure rights. They may also have better management plans, infrastructure development, veterinary services, literacy and marketing channels. The initiative originates from the migration of pastoralists from the northern provinces to the more humid southern Soudanian zone. The conflicts that were ignited with these migrations led, in 1978-80, to the identification of altogether 44 potential pastoral zones in Burkina Faso, of which six are in Boulgou Province:

Nouhao	200.000 ha
Donbéguéi (Bagré)	7.000 ha
Tcherbo (Bagré)	6.000 ha
Sablogo	30.000 ha
Niassa	19.000 ha
Zoaga	50.000 ha

Table 8 Proposed pastoral zones in Boulgou province (Danida, 1995)

The 6 proposed zones in Boulgou province make up 14 % of the number of zones defined nation-wide, while Boulgou, being one of 30 provinces, only makes up 3% of the total area of Burkina Faso which indicates the importance of the province with respect to animal husbandry. Altogether, the surface that is identified as potential pastoral zones covers almost a quarter of the province.[49]

Of these 6 proposed zones only the Nouhao valley has been realised and is still in operation despite lack of funds. It covers altogether 200.000 ha, of which the central 95.000 ha are reserved for pasture. The project management covers veterinary and agricultural services, the establishment of fire breaks, secure land rights, literacy, the formation of pastoral groups, a dairy, and the education of women in milk-production. Animal density is kept at a maximum of approx. 3,8 ha/TLU.[50] The transhumant pastoralists are not allowed to enter the zone. The pastoralists in the area seem to be well off and in general experience few conflicts. However, the management of the zone that used to be financed by the FAO is now in severe need of funding, and my own experience demonstrated that probably the most important aspect of the management, the securing of land rights, is not effective.[51]

Especially interesting are the pastoral zones around the Lake Bagré. Animal density in these two zones is as high as 1 ha/TLU compared to 3 ha/TLU for the province in general. The lake

[49]Calculations based on Danida (1995). Only the pasture part of the Nouhao pastoral zone has been included in the calculation, not the agricultural areas that are 1,1 times larger than the pasture area.

[50]36.000 heads of cattle = 25.200 TLU. Again, only the 95.000 hectares for pasture have been included in the calculation.

[51] Also personal communication with Charles Ouedraogo, Director Projet Nouhao.

and its bordering areas have a large potential both with respect to animal husbandry and cultivation, and the proper securing of water and land rights here will probably have a large influence on the whole region's future as an animal husbandry dominated region. This is because of the planned comprehensive irrigation and cultivation management schemes that will result in a partial closing off of large parts of the lake shores. At the same time, farmers are eager to open land for cultivation in order to claim land rights when the irrigation management is begun. These two zones are therefore not only potentially profitable with respect to cultivation, but are also extremely conflict prone. The pastoralists in the area are trying to organise themselves in an association with the goal of securing a large part of the land adjacent to the lake for animal husbandry. However, the outcome of this initiative was at the time of the fieldwork far from clear.

2. Animal husbandry management systems

Animal husbandry in the region may be divided into three types:

1) Animals held by the sedentary pastoralists who often "belong" to a Bisa/Mossi village and who herd both their own and the farmers' animals.

2) Animals of the Bisa/Mossi farmers often used for traction in connection with soil preparation and weeding.

3) Animals of transhumant pastoralists from northern provinces passing through the area in the dry season in search of pasture, residue grazing and water.

a) Animal husbandry of the sedentary pastoralist

This is the most widespread form of animal husbandry in the region and is the main object of the study. The pastoralists belong to the ethnic group Fulani, which is a common name for several heterogeneous classes of people who all identify themselves as primarily cattle keepers, and thereby differentiate themselves from the surrounding West African predominantly agricultural patterns of life.[52] Grayzel (1990:36) proposes three characteristics that makes them a distinct group: an inherent identification with cattle raising even if they own none, an awareness of a shared identity as Fulani meaning "free cattle people", and a set of cultural values and behavioural rules identified as *"Pulaade "*. The Fulani are scattered all over West Africa and most often live in small more or less permanent hamlets. In Burkina Faso, Fulani society is largely composed of the Fulbe and the Rimaibe (Riesman, 1990:324).[53] The Fulbe, referred to in the study region as Peul Blanc, are the former noble class predominantly occupied with cattle rearing but also to a minor degree with crop cultivation who kept the Rimaibe

[52] Fulani is the common English name and is used here without distinction between sing, and plur. They have, however, many synomyms. Often, they are referred to as Fulbe (sing. Pullo) or in French, Peul. They are also named Fula by Mandingoes, Fellani (sing. Bafellanchi) by Hausa, Fellata by Kanuri and Fullan by Arabs (Barth 1858 cited in Grayzel, 1990:35).

[53] Also spelled RiimaayBe

as slaves (Riesman, 1990:325; Riesman, 1974:31; Bruijn and Dijk, 1992:48). The Rimaibe are predominantly agriculturalists who do only little cattle rearing and are distinct from the Fulbe also with regard to social customs and values. In this study, only Peul Blanc are dealt with as they are the dominant group in the study area and will henceforth be referred to as Fulani. They live in patrilineal clans and are active Muslims. The Marabout (Muslim priest) plays an important role in the society as master in the Koran school.

Most of the Fulani have lived in the region for many years, often having arrived simultaneously with the neighbouring Bisa/Mossi farmers. They seem to have very close links with the Bisa/Mossi farmers, and regard themselves as part of the village society. A frequently-used expression is "our Fulani" or vise versa "our Bisa" indicating a sort of traditional ethnically-based intra-village specialisation.
The Bisa divide the Fulani into the "new" Fulani and the ones who have lived with the Bisa/Mossi for a long time. The "new" Fulani have installed themselves after the drought in the 1970's and are not as well integrated into the Bisa/Mossi society as the "older" Fulani. Intermarriages between Fulani and Bisa/Mossi do not normally occur. The "older" Fulani are represented by a Fulani chief whose primary objective is to act as an intermediary between the agriculturalists and the pastoralists in cases of conflict (Faure, 1990). However, Fulani power relations are diffuse and if the community has a leader it is out of respect for his conduct and intelligence (Grayzel, 1990:42).
It is common that the sedentary Fulani tend the animals of the Bisa/Mossi farmers in an entrustment system, as discussed previously (page 63).

The size of the animal flocks is very varied and difficult to ascertain. Not only are the Fulani reluctant to give the true figures, but the ownership structure of the flocks may also be complex and opaque. Herds of around 30-40 cattle may not be an exaggeration (Danida, 1995; Delgado, 1979b; own data). Cattle are dominant, with sheep second and goats to a minor degree.
The herding of the animals is dependent on the available natural resources. Grazing distances are normally of a moderate magnitude (less than 30-40 km) as pastures and water can normally be found in the vicinity. The pattern is determined by the availability of pasture and water and forced exclusion from cultivated areas. During the cultivation period in the rainy season, the herds are taken to distant pastures and led to the watering points following more or less permanent cattle corridors. However, as the corridors are few and badly fenced off, if at all, divagation can be hard to avoid leading to damaged crops, disputes and claims for compensation.
When the harvest is over, the herds are brought back to the village fields to graze on the crop residue. Both the Fulani fields and those of the Bisa/Mossi farmers are grazed, thus contributing to the fertility of the soil through the supply of manure. Night paddocks are often made

during this period but almost exclusively on the Fulani's fields. Later on in the dry season more distant pastures may be sought near the riverbeds.

Diseases among the cattle are a problem but do not seem to be a severely limiting factor. Vaccinations (up to 5) are made annually by the local veterinarian service. Diseases among small ruminants seem to be a more serious problem. Trypanosomiasis still occurs to a minor degree mainly due to the southward migration of animals. However, the creation of Lake Bagré may provide suitable living conditions for the tsetse-fly (Glossina spp.), which is a vector for the trypanosome parasite (Danida, 1995).

b) Transhumant Fulani

The transhumant Fulani were previously an important part of animal husbandry in the region, especially as onchocerciasis left large grazing areas unused but are today probably less prevalent and are often not mentioned by the villagers.[54] However, it is difficult to get accurate information on this very mobile group and some uncertainty as to their importance and magnitude thus prevails. They come from northern distant villages like Boulsa (100 km north of Tenkodogo) and Koupela with large herds and head towards the southern parts of Boulgou, the Bagré Lake or the neighbouring provinces of Nahouri, Sissili and Zoudwéogo.
They arrive when the harvest is over (end Nov.-Dec.) and return when the rains begin in April-May. Usually, the elders and other family members stay behind. No specific routes are followed as the harvest is over and residue grazing is free in principle. Yet some may follow the riverbeds into the region because of available water and pasture. The animals either belong to them or are entrusted to them by absentee owners, farmers or other Fulani residents in their home region.

Seeking waterpoints and good pasture, they are in direct competition both with local farmers and the sedentary Fulani. Earlier, a common practice would be that the transhumants settled on fields close to the village, used the village well and the women would sell milk to the farmers. Now, with the increase in animals both among Bisa/Mossi farmers and Fulani, the influx of settled Fulani and the expansion of the agricultural areas, the resources are no longer abundant to the same degree, and the transhumant Fulani are generally not popular either with the Bisa/Mossi farmers or with the settled Fulani. This has apparently led to a decrease in the number of transhumant animals from around 1990 and serious conflicts have occurred.
The transhumant Fulani are badly covered by the veterinary services, as they are difficult to locate in the often inaccessible terrain. The authorities therefore have no control over them and, as consequence of the bad veterinary coverage, the conflicts and the competition among the different users of the resources, have tried to limit their movements and transform them into agro-pastoralists (Danida, 1995). Current development trends seem to be against the

transhumants, and their future as a way of life seems uncertain. The transhumant Fulani have only to a small degree been included in the present study, partly for practical reasons and partly because the focus is on the animal husbandry of the sedentary Fulani and their interactions with the farming society.

c) Bisa/MoBsi farmers

The animal husbandry of the sedentary Bisa/Mossi farmers takes place on a much more modest scale compared to the previous two forms. Small ruminants and poultry are more important and cattle, though widespread, are mostly common among the better-off farmers. It is estimated that around 1/3 of the Bisa/Mossi farmers have cattle (Danida, 1995).

The cattle are primarily used as draught animals but also as an investment or for fattening with the aim of profitable sale in the near future. With the emergence of the cart, the donkey has gained importance.

Farmers who only have few animals for draft normally have their children herding them on fields and pastures close to the household.

With respect to the investments the "interest rate" for animals is based on the natural rate of increase for the specific specie. This ranges from 5% (camel) to 30% (goats) but intra-annual price fluctuations may end up providing even more attractive interest rates (Sandford, 1989). For cattle, a typical interest rate would be around 20% (Delgado, 1979a:314).

The size of the herds ranges from 10-50 small ruminants and from 1-15 cattle and donkeys. Figures like these are, however, merely estimates covering large variations, and are also difficult to confirm.

The herds of the Bisa/Mossi farmers seem to have increased during recent years which is probably related to the higher profitability of having animals, and to the use of draught animals.

Three different forms of Bisa/Mossi farmer cattle ownership may be defined according to the management practices.

For the pure purpose of profitable meat sale, a variant of the 90-day intensive on-farm feeding model may be found. Here, relatively emaciated cattle are bought at the end of the cropping season, fed on-farm with high-energy fodder and sold when prices are higher at the end of the dry season (Delgado, 1989:352). This model has the advantage that it does not interfere with the agricultural work during the rainy season, and it takes advantage of seasonal price fluctuations. However, a certain economic surplus and access to high-quality fodder, or the cultivation of forage crops will be a precondition that is only present to a limited extent among the average Bisa/Mossi fanner in the Boulgou province.

[54] Also personal communication with Gustave Dabillougu, Encadreur/Veterinary, Garango

Another option is the so-called growing-out model. Here, cattle are kept on the farm for several years and possibly sold around the age of ten for meat (ibid.). The animals are basically used for draft, manure, milk supply, and economic security. The growing-out option is therefore a basic constituent of the mixed farming model. The disadvantage is the labour requirement of the animals during the agricultural peak season and the associated opportunity costs. Without the entrustment option, this would be the most common cattle management strategy.
Over the last 10 years or so, there seems to have been a rise in the occurrence of theft. The fear that these incidents give rise to has made farmers reluctant to leave their animals in night parks, and instead they keep them behind walls and fences in their own courtyards.

3. *Entrustment*

As mentioned earlier, the entrustment system is central for the animal husbandry of the Bisa/Mossi fanners as well as for the Fulani. According to Faure (1990), 40% of the cattle in the region is owned by the Bisa/Mossi farmers and entrusted to the Fulani. Up to 2/3 of the Fulani cattle may be owned by the Bisa/Mossi farmers and it is further estimated that between 1/6 and 1/3 of the Bisa/Mossi farmers have at least one head of cattle entrusted to the Fulani (Delgado, 1978; Delgado, 1979a). Absentee ownership, where people living outside the local community typically in urban areas own the animals, does not seem to be prevalent.

The entrustment system was discussed more thoroughly in the theoretical chapter, and the Delgado study from the late 1970's was extensively used for reference. The conclusion in this study was clearly in favour of the entrustment system and is therefore an important support for the findings of the present study as it is shown that the break-down of the entrustment system has negative consequences for the farmers' animal husbandry and hereby the possibilities for further agricultural intensification in the area. However, the Delgado study rests on 6 important assumptions (page 68) (Delgado, 1979a:306), and as it is 20 years old and situated around 20km from the present study area it is important for present day validity to examine these assumptions in the local context.

Assumption 1: The presence of the entrustment system, is still valid in the present study area. The fact that the system is disappearing will make animal husbandry less feasible for the farmer, which means that this assumption may today be even more critical for the farmer's animal husbandry than it was 20 years ago.

Assumption 2: Relatively high population density (40 pers./km^2 in this case), is still valid, and has probably even augmented. The Delgado study area today has a higher population density than the present study area. However, with a present day average density of 55 pers./km^2 in Boulgou province and the present study area situated in a relatively densely-cultivated zone, it is most likely to have a population density at least in this order. The population density fig-

ure was, in the Delgado study, indicative of the pressure on the arable land, and hence the labour requirements of herding the cattle. As this is one of the major problems in the present study area, as will be shown in the further analyses of data, this assumption is also valid today in the present study area.

Assumption 3: Absence of a viable forage crop, and assumption 4: Absence of abundant supply of feed supplements, are still valid in the region as very few farmers or pastoralists find this practice feasible.

Assumption 5: Absence of manpower-supply during peak periods or labour saving technology is harder to verify, as detailed analysis of the labour economy was not undertaken in the present study. However, an important motivation for the Bisa farmer in the present study area to entrust animals to the Fulani is the lack of labour, which supports the continued validity of this assumption. Animal traction is, despite the findings of the Delgado study that it is not likely to be economically feasible, today rather widespread in the present study area as around half of the fanners use it. This could indicate that the assumed absence of labour-saving technology is no longer valid. However, labour saving technology would also imply higher labour productivity, which could favour entrustment as it would raise the opportunity cost of herding the animals. If more crops can be harvested with less labour, using this labour for herding would result in a higher loss in terms of harvest. Labour-saving technology could also free up labour that would then make animal husbandry more feasible, but as grain self-sufficiency is not a general characteristic it could be assumed that labour-saving technology would be used to increase the harvest, implying that opportunity costs related to labour would rise. This assumption, therefore, can work both in support of and against entrustment.

Assumption 6: Soils and tenure arrangements (location and size of fields) unfavourable to animal traction, is at least partly also valid for the present study area. The soils are similar to the soils found in the Tenkodogo area with the same agricultural potential. The number of fields used by a household is today still significantly lower in the present study area compared to the Tenkodogo area (Mertz and Reenberg, 1999). Assuming that the land available to a household is similar in the two areas this would indicate that the fields are larger in the present study area. Although the fields have not been measured in the present study area, this specific assumption may today not be valid to the same degree.

Since the Delgado study, the milk yield from the cows has, according to the respondents in the study area, decreased. To the extent that this is a general trend it would mean that the economic loss to the farmer because of foregone income from milk sale would diminish, which would make entrustment even more advantageous. However, for the pastoralist, for whom the income from and the consumption of the milk are important, taking entrusted animals will be less attractive.

The expansion of fields in the present study area makes it more difficult for the herder to keep the animals away from the crops during the rainy season. This will make herding more labour-intensive and is thus an important incentive for the farmer to entrust. Expansion has increased during the last 20 years, though it is not known whether the present study area now has a field density that corresponds to the density of the Delgado area in the 1970's.

There are therefore clear indications that the feasibility of having animals for the fanners is still closely linked to the entrustment system. A breakdown of the entrustment system may, therefore, have a significant impact on the feasibility of animal husbandry in the region as the Bisa and Mossi farmers represent the vast majority of the population. As mixed farming is closely related to the agricultural intensification process this is also likely to have a negative consequence on the agricultural potential of the region and thereby also on the inhabitants'possibilities for sustaining a secure and satisfactory livelihood.

4. Commercialisation

Animal husbandry in Boulgou province has, as mentioned, increased considerably during the last couple of decades. It was mentioned that this may partly be ascribed to the southward migration of pastoralists and cattle, but there are also important economic incentives for increasing the number of animals. In the following section, some of the central issues in relation to the economic feasibility of animal husbandry will be described.

Burkina Faso has an important potential in animal husbandry because of a comparative advantage in relation to its southern neighbours. The climate of West Africa is characterised by latitudinal isohyets with a strong north-south rainfall gradient. One of the implications of this is that north-south also becomes the dominant direction of exchange of goods. Because of the humidity in the southern coastal areas, agricultural potential is high, while animal husbandry potential is low due to diseases like trypanosomiasis. In the Sahelian countries, the situation is the opposite as agricultural potential is low due to the semi-arid climate, while the vast grasslands offer important grazing potentials for cattle in a relatively disease-free environment. Besides, the coastal countries have a large industrial potential which results in high urbanisation rates. This reinforces the animal husbandry potential of the Sahel, as increased urbanisation stimulates the demand for meat, while at the same time the demand for a low status stable food like millet, which is the main cereal in the Sahelian countries, is substituted by rice and maize and other high status cereals.[55] Thus, the Sahelian countries have important comparative advantages with respect to animal husbandry, while agriculture is likely to face an increasing demand for crops that are not feasible (Snrech, 1995).

[55] Partly based on Jeremy Swift, oral contribution to the 6th Danish Sahel Workshop, Sønderborg, January 2000

But also domestically the demand for meat may be expected to rise. The general population increase (2,6-3,3 % depending on the source; (Jeune Afrique, 1992:29; Danida, 1990)) alone has led to increased demand for meat and other animal products, as has rapid urbanisation of 8% p.a. urban population growth (Jeune Afrique, 1992:29; Danida, 1995:197). The population of Ouagadougou between 1975 and 1996 increased from 475.000 to 1.8 million (Jong *et al*, 2000). People living in the cities generally have a higher standard of living, suggesting that a higher portion of their diet consists of animal products.
The increased use of animals for traction has also led to higher demand for animals, notably donkeys and high-quality oxen.

The increased demand for animals is reflected in higher prices, although the prices are also conditioned by other factors than crude supply and demand. Politically-determined regulations of prices like devaluation and taxes are also important, and a recent devaluation has had a significant impact, as will be discussed below.
How pronounced the price increases in animals have actually been is rather hard to get accurate figures for. The first indices come from the farmers and Fulani in the area that unanimously contest that prices have increased a lot, especially during recent years.
The prices for the animals are highly variable as a function of season, age and condition of the animals and special market situations like drought, etc. In normal years, most cattle are sold in the dry season. The prices on Pouytenga market are often highest around March and lowest around October, but a clear trend is not discernable (DSAP, 1996:64). In 1996, a young cow on the local Garango market at the age of 3 years may cost around 50.000 CFA while an older one of 9-10 years may cost between 100.000 and 200.000 CFA. Drought animals, that are not too big, may cost from 75.000-110.000 CFA. In bad years, the price for a good cow may drop to 50.000 CFA. These figures are composed from the statements of 6 Bisa/Mossi farmers and Fulani. The price estimates were varied, and the above figures may therefore only provide a rough guideline to the price level. This trend, however, is confirmed by official statistics shown in Figure 8. Since 1993, prices have increased considerably. From 1993 to 94 the prise for a good bull on Pouytenga market rose 48%, and a further 19% from 1994-95. Figures from first trimester 1997 suggest that prices have stabilised at this high level (CMAAOC, 1997:11).

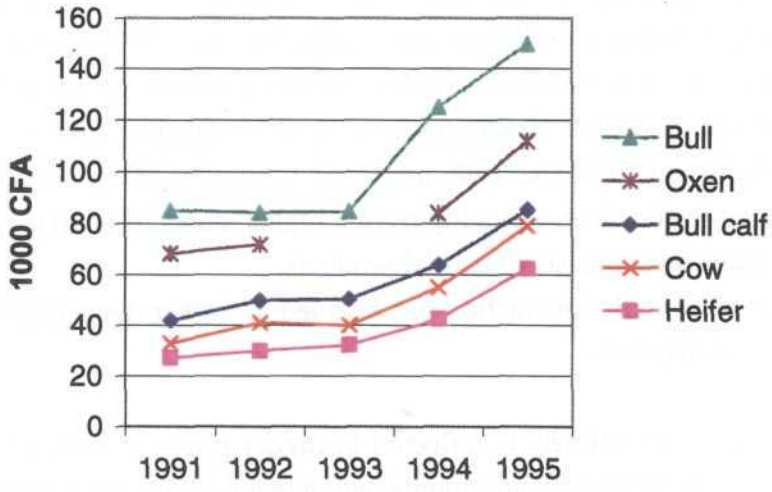


Figure 8 Pouytenga market mean annual cattle prices 1991-95. Bull =male >3 years (Y), Bull calf= male 1-3Y, Oxen= castrated male > 3Y, Heifer=female 1-3Y, Cow=female >3Y. Source: (DSAP, 1996, 1994, 1992, 1991)

On January 12, 1994 the CFA was devaluated to 100 CFA per French Franc (FF) from 50 CFA per FF at which it had been fixed since 1948. This had the immediate effect that exports were rendered cheap while imports became expensive. A measure apparently favouring the balance of trade in general and especially the terms of trade for animals (Gabas and Mainguy, 1995; Uku, 1995). For countries outside the CFA zone (Ghana and Nigeria principally), this meant cheap importation of meat. For the coastal countries within the CFA zone (Côte d'lvoire, Togo, Benin etc.), the prices of Sahelian meat were initially constant, but imported meat, especially from EU became much more expensive. As these countries do not have the same favourable conditions for animal husbandry, the demand for meat was directed towards the high-quality Sahelian meat. This increased demand for Sahelian meat led to general price increases for animals on the markets of Burkina Faso as mentioned above. The devaluation, therefore, has had and has a very important positive effect on animal husbandry in Burkina Faso, though certain inputs like veterinary products have become more expensive (Sidwaya, 1994).

Boulgou province is located close to two important export markets, Ghana and Togo, number 2 and 3 after C6te d'lvoire, and also domestically it is favoured by the largest market for animals in Burkina Faso, Pouytenga, which is situated only 60 km north of Tenkodogo (DSAP, 1996; Bernard, 1966; Agroalimentaire, 1994; Sidwaya, 1994). Boulgou province, thus, does not only profit from the proximity of the major export markets, but also of the major domestic market.

The Fulani and the Bisa/Mossi farmers sell their animals either to traders who come to the villages or, more commonly on the nearest larger market. The traders gather large herds in Tenkodogo or other commercial centres, and hire Fulani to escort the herds on foot to the neighbouring countries where they are sold on the large markets. The most common markets are Ghana and Togo, where Ghana seems to have taken the lead after the devaluation (SPRA pers.comm.). The prices vary considerably on the market according to season.

Figure 9 Pouytenga animal market

Exports prior to the devaluation did not show increases during the seventies and eighties. Since 1975, exports to the coastal markets actually declined due to self-sufficiency policies commenced in these countries and the general economic crisis. In the eighties, subsidised EU frozen meat exports to the coastal markets led to a further decline or at least a stagnation[56] (Danagro, 1992; Danida, 1990). Thus export demand prior to the devaluation has probably not had a significant impact on the increase in animals, though it is possible that the deficient exports led to domestic accumulation of animals (Agroalimentaire, 1994).

After the devaluation, exports on a national level have risen considerably (Agroalimentaire, 1994; Sidwaya, 1994; Uku, 1995). Figures from the first trimester 1992-93 and 1994 suggest a 57% increase (Sidwaya, 1994). These are the official figures and it may be expected that a considerable portion of the exports have not been registered, which further reinforces the effect. The export of live animals from Boulgou has risen almost fourfold from 1993 to 1994 as can be seen from Figure 10. However, data are somewhat unreliable and probably underestimated.[57]

[56]The sources are not unanimous on this point. The Danagro report (1992) and an article in Agroalimentaire (1994) claim a large decrease in exports, while World Bank statistics in the Danida report (Danida, 1990) show a rather constant level. Atlas Jeune Afrique (1992:40) shows large decline after 1986.

[57]Only exports that the traders themselves report to the SPRA are registered. It is well known that much export is never registered, but the magnitude of this is unfortunately not known.

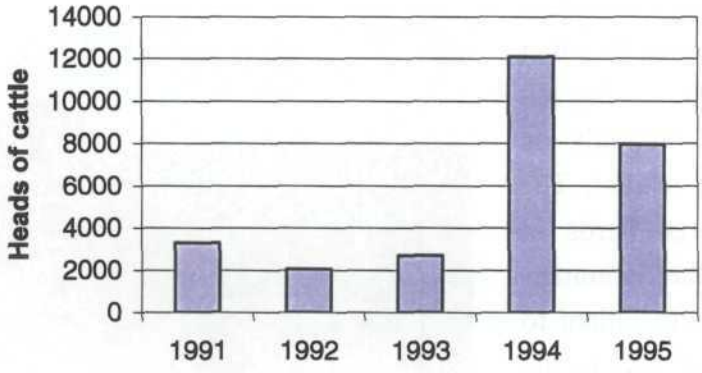


Figure 10 Cattle exports from Boulgou 1991-95. (DSAP, 1996:39)

As mentioned, the majority of the animals in Boulgou are exported to Ghana and Togo. During the last ten years, the market situation for animals has been rather difficult due to exports from the EU. These frozen meat exports were subsidised by up to 70% of their price, which was around 300-400 CFA/kg. The Sahelian meat was sold for 700-800 CFA/kg and could therefore not compete with the European exports, though it was superior in quality. However, with the devaluation of the CFA the price of European meat has attained a level similar to Sahelian meat, thus turning the advantage to the latter because of its superior quality (Agroalimentaire, 1994). Furthermore, the EU has, for political reasons, reduced price subsidies on frozen meat exports to the West African coastal markets, which led to a 47% decrease in African imports of EU meat from 1995-96 (CMAAOC, 1997). This has led to a doubling of exports from Burkina Faso in 1994 compared to 1993 (Agroalimentaire, 1994; Sidwaya, 1994).

Figure 11 Cattle drive in Boulgou towards Ghana and Togo

On the other hand, the domestic market has suffered from the general price increases described above. The slaughterhouses in Ouagadougou thus report a drop in production of 30-35% (Agroalimentaire, 1994; Sidwaya, 1994). Thus, prises on the domestic market have almost doubled (from 550 CFA/kg to 950 CFA/kg), even surpassing prices on the export markets (Côte d'lvoire market-price 850 CFA/kg approx.) (Sidwaya, 1994).

An interesting question is whether the positive effect of the devaluation will last. A devaluation like the one experienced in Burkina Faso leads to a rise in general living costs, as all extra-CFA zone imported goods will become more expensive. Even for a country like Burkina Faso where general consumption is not dominated by imported goods, especially sought-after luxury goods that for the most part are imported, will probably lead to a demand for higher payments which again may eventually lead to inflation. Also manufacturing, that for the major part depends on imports for over 70% of its inputs (Uku, 1995), will suffer from high rises in production costs, eventually leading to rising prices. In this way,the early effects of the devaluation will be undermined when the prices of exported goods increase with the general price increases. The 1995 figures show a 15% decline in cattle exports (34% for Boulgou), however, this reduction is seen as an adaptation of the market to post-devaluation price levels resulting from a shift in consumer patterns from beef to chicken and fish combined with rising costs of transport (Faes, 1996). Besides, the high export levels of 1994 may partly be ascribed to extraordinary high Ghanaian demand and a possible destocking by the pastoralists to exploit the advantageous market situation. 1995, with slightly lower levels of exports, may therefore perhaps be seen as a more normal post-devaluation year, still attaining export-levels well above (46%, 300% for Boulgou) the pre-devaluation level (Ibid.).

The effects on meat or rather animal exports will last as long as the coastal markets do not find cheaper alternatives. As mentioned, their possibilities for creating self-sufficiency are limited, and attention therefore has to be guided towards alternative imports. For political reasons, the EU may not be expected to re-subsidise their meat exports but then Latin American meat exports could pose a threat. Whether Sahelian meat is going to become more expensive because of general price and wage increases that may encourage domestic and especially urban meat consumption, is a possibility. However, given the large potential of animal husbandry in Burkina Faso, and the massive presence of animals, this effect is probably not going to be pronounced in the near future. There are, therefore, no obvious reasons why the positive conjuncture for Sahelian animal husbandry should be merely a short-term phenomenon.

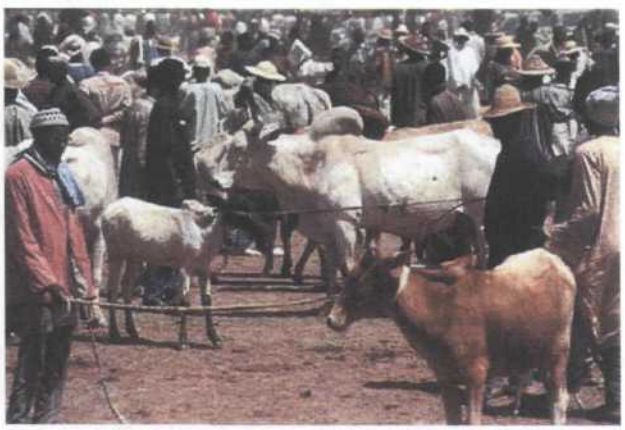


Figure 12 Pouytenga animal market

D. Intensification and animal husbandry in Boulgou

With reference to the preceding description of the study region, the following section will try to sum up what elements of agricultural intensification can be identified in Boulgou and also what would have been expected following theoretical models of intensification. It will be shown that agricultural intensification has only developed to a small degree in Boulgou, and comparisons with neighbouring regions will show that intensification as a feasible option in these regions is doubtful. The section will end up with a summary of the main characteristics of animal husbandry in the region and how it relates to agricultural development.

The climate is supposed to be relatively well suited to intensification as it is in the medium rainfall zones (751-1200mm) that permanent cultivation is most easily sustained (Pingali *et al,* 1987:52-54).[58] Also, trypanosomiasis hinders the development of animal traction in humid regions with substantial forest cover.

The infrastructure is also relatively favourable with good access to nearby important markets, yet good infrastructure alone does not lead to intensification. Without good soils the benefit of the improved infrastructure will be lost (Pingali *et al.,* 1987:48) and in Boulgou the soils are generally of poor quality for agriculture.

As described in previous chapters, the region is characterised by a relatively high population density, growth, and an influx both of pastoralists and peasants. However, population densities are still not as high as have been observed in the successful cases of autonomous intensification.

The usufruct rights of the farmers and especially the pastoralists cannot be considered secure, and official tenure policy is neither clear nor tested out.

Therefore, some the most important preconditions for intensification as listed by Hydén et al. (1993) and Tiffen et al. (1994), namely a favoured environment and a flexible tenure system cannot be said to be present in Boulgou.

However, as described in previous chapters, a certain potential for animal husbandry is present in the form of nearby markets and a favourable environment. Besides, the future irrigation management plan envisaged for the Bagré Lake, does nevertheless point to some favourable conditions.

An assessment of the possibilities of intensification in the area is therefore uncertain. What can be said, though, is that the preconditions are not as favourable as they have been in areas where a positive "Boserupian" intensification has taken place.

According to the standard intensification models discussed in previous chapters, several changes would be expected to occur in the Boulgou province should the preconditions be ful-

[58] see also the discussion on mixed fanning page 46

filled. Concerning crop-cultivation, intensification would result in increased frequency of cultivation, increased mechanisation in the form of the ox-plough, privatisation of land, introduction of higher yielding cash-crop varieties and increased use of manure, in-organic fertilisers, herbicides and pesticides.
Regarding animal husbandry, this intensification would lead to fodder cultivation, changes in herd-composition towards a higher proportion of reproductive cows, more intensive use of crop residue and manure, increased market integration and possibly less mobility.

These things have only, as discussed previously and to be further elaborated upon in the primary data analysis, to a small degree taken place in Boulgou Province. Some of them, like fodder cultivation, have been introduced by the local extension services, but without success. The introduction of animal traction in Boulgou primarily led to the expansion of extensively-cultivated areas instead of to intensification (Faure, 1990:236).
This may be explained by the fact that not all the conditions enabling autonomous intensification are present, or at least they are not sufficiently influential to trigger the process. Factors that come to mind here include the modest agricultural potential of the region. The climate is too dry and the soils too poor to sustain larger capital investments in tools, draught oxen, improved varieties or appliances. The market incentive for the crops may not be sufficiently important to justify a significant shift from subsistence to cash crops, and the required labour may not be available. Also, the diversity of the agricultural system is high, reflecting a risk-minimising strategy (Mertz and Reenberg, 1999), which should be taken into consideration when considering what kind of agricultural intensification would be feasible in Boulgou.
There are, therefore, several issues that are not in favour of intensification in Boulgou. The one described here concerns the preconditions that are critical for intensification to take place. However, the expansion paradox may also hinder such a development. It is, of course, difficult, if not impossible, to say which factors are the most important. The cases presented in the following show that the expansion paradox is relevant, though it cannot be isolated as the only reason for the apparent lack of intensification in the area. By establishing these relations, though, a better understanding may be gained of the forces at play in natural resource management.

With regard to animal husbandry, fodder cultivation may still be too arduous when alternative natural pastures are still available, while the other factors mentioned can probably be identified, although their influence may vary. This might confirm that some modest autonomous intensification has taken place within animal husbandry, but that the crop-cultivating activities in the region are predominantly characterised by expansion rather than intensification.

The case of the Kusasi area a bit further downstream of the Nakambe (previously White Volta) in northern Ghana may give some clues as to Boulgou's prospects.

This region neighbouring Boulgou to the south (see map page 7), is environmentally very similar. The population density as well as the precipitation is slightly higher than in Boulgou, but agricultural practices, agro-ecological potential and the recently-opened onchocerciasis areas are similar. Governmental influence or support may, however, be lower than in Boulgou, as this northernmost part of Ghana has officially been regarded as marginal and primarily as a supplier of labour for Ghana's southern core cash-crop and mining areas (Webber, 1996:444). In Burkina Faso, the southern parts of the country represent the highest potential, and more official interest may therefore be expected to be invested there.

Webber (1996:437) describes the Kusasi area as being more typical of the densely-settled areas of the semi-arid trans-Volta region of West Africa than the Machakos area in Kenya. His study of the region concludes that in spite of a 20% adoption of the ox-plough, which enabled farmers to cultivate a larger area, the region is so marginal economically and environmentally that intensification has not been able to take off, with the result that the fertility of the compound fields has declined so drastically that they no longer can provide the necessary subsistence for the households. As in Boulgou, fanners have begun to clear the dense savannah woodland in the recently-opened river-valleys, and have begun to move to the valleys on a semi-permanent basis as a response to the declining fertility and outcome of the compound fields. The petty trade present in the area and the remittances from migrated family members have not been able to provide the necessary capital for investment, and government support has been insufficient. Webber therefore concludes that population growth alone has not been sufficient to trigger intensification process in the Kusasi area.

Livestock is very little described in Webber's study, and only in relation to the provision of draft power and manure supply, as in the classical mixed farming model. Therefore, Boulgou may have an advantage not present in Kusasi.

Another study in the neighbouring region to Boulgou in Togo also gives some clues to the possibilities for intensification (Faure and Djagni, 1989). The region is similar and neighbours Kusasi with a slightly higher rainfall level and population density (58 per./km^2) compared to Boulgou. In this northernmost part of Togo, animal traction has been actively promoted by the extension services, and in 1986 around 15% of the farmers had acquired the necessary equipment while more than half of the farmers used it without owning it. However, the introduction of animal traction did not lead to higher yields or to a higher cultivated area per person, since there was already considerable pressure on the land and because population growth is as high as in Boulgou. The main benefit of the animal traction was that the labour-intensive land preparation could be done faster and more easily. However, the direct income from hiring out the equipment and the animals was a very important factor for the feasibility of the animal traction. It was also shown that it was primarily the better-off farmers with large households and hence a larger working force, who owned animals beforehand and had access to off-farm income, who were able to master the investments necessary. The majority of the fanners did

not have the necessary means. For the households who adopted animal traction, this was generally followed by a slight increase in the area sown with cash-crops.
The study shows that even under slightly more favourable conditions, autonomous agricultural intensification in these areas cannot be expected. The feasibility of animal traction as a means to an intensified agricultural system is fraught with uncertainty in these environments and off-farm income becomes important as agricultural potential is relatively low. However, it also shows the importance of animal ownership for the introduction of this technology, which may further underline the importance of the entrustment system in Boulgou as this system significantly improves the feasibility for the farmer of having animals.

E. Summary

Boulgou province has a relatively high animal density and the natural resources offer quite good opportunities for animal husbandry in the form of pastures, crop residue and water availability. Also, the sanitary conditions are favourable and the proximity to important markets all add to relatively favourable conditions for animal husbandry. Economically, animal husbandry has experienced a positive development, with increasing prices due to rapid urbanisation and favourable export conditions reinforced by the 1992 devaluation of the CFA.
However, in the light of the Kusasi case it seems likely that the lack of intensification in agriculture means that expansion will continue with the opening of the riverbeds at the expense of grazing areas with nearby water resources. Animal husbandry (and the Fulani) are likely to become increasingly dependent on access to residue grazing on the farmers' fields, and the Fulani will increasingly be forced to cultivate themselves, leading to the associated opportunity costs.
The entrustment system, which is crucial for the feasibility of animal ownership by farmers, is still active, which should allow the major population groups, the Mossi and the Bisa farmers, to reap the benefits of animal husbandry in the form of animal traction, manure supply and economic profitability with minimum opportunity costs related to the allocation of labour to agricultural activities.
However, rapid agricultural expansion reduces the natural pastures, and competition over access to resources and conflicts over crops damaged by stray animals may lead to an undermining of the entrustment system that builds on good relations and mutual trust between farmers and pastoralists. Thus, it is important for the economic potential of the region that the entrustment system may survive, so that the pastoralists are not marginalized due to their ambiguous tenure situation.

These tendencies take place in a complicated local context. In the following, a specific community of two interrelated fanner and pastoralist societies will be studied in depth, thus providing cases embedded in the local context which reveal the mechanisms governing current developments.

VII. Agriculture and pastoralism in Boulgou - the cases of Sanogo and Lergo villages

The following is a discussion of the changes that have occurred in the study area with respect to animal husbandry. Two Fulani settlements and the related Bisa villages are used as cases to illustrate these changes. Sanogo has a densely-cultivated territory and the Fulani have split up their households and moved away with the herds in the search of better pastures. Lergo, a few kilometres further south, still has uncultivated land in the proximity of the village and the Fulani maintain their herds in the vicinity of Lergo, albeit with increasing difficulties. Because of their proximity and close relations, a comparison between the two villages reveals the process of change which the two societies are going through. They may not represent actual stages in a specific development trend, but the changes that have taken place result from similar processes. The comparison is illuminating, as the changes that have already taken place in Sanogo can be identified in Lergo today.

In the following, the Bisa and the Fulani villages will be treated separately. For convenience, the Bisa villages are called Sanogo Bisa and Lergo Bisa, while the Fulani villages are called Sanogo Fulani and Lergo Fulani.

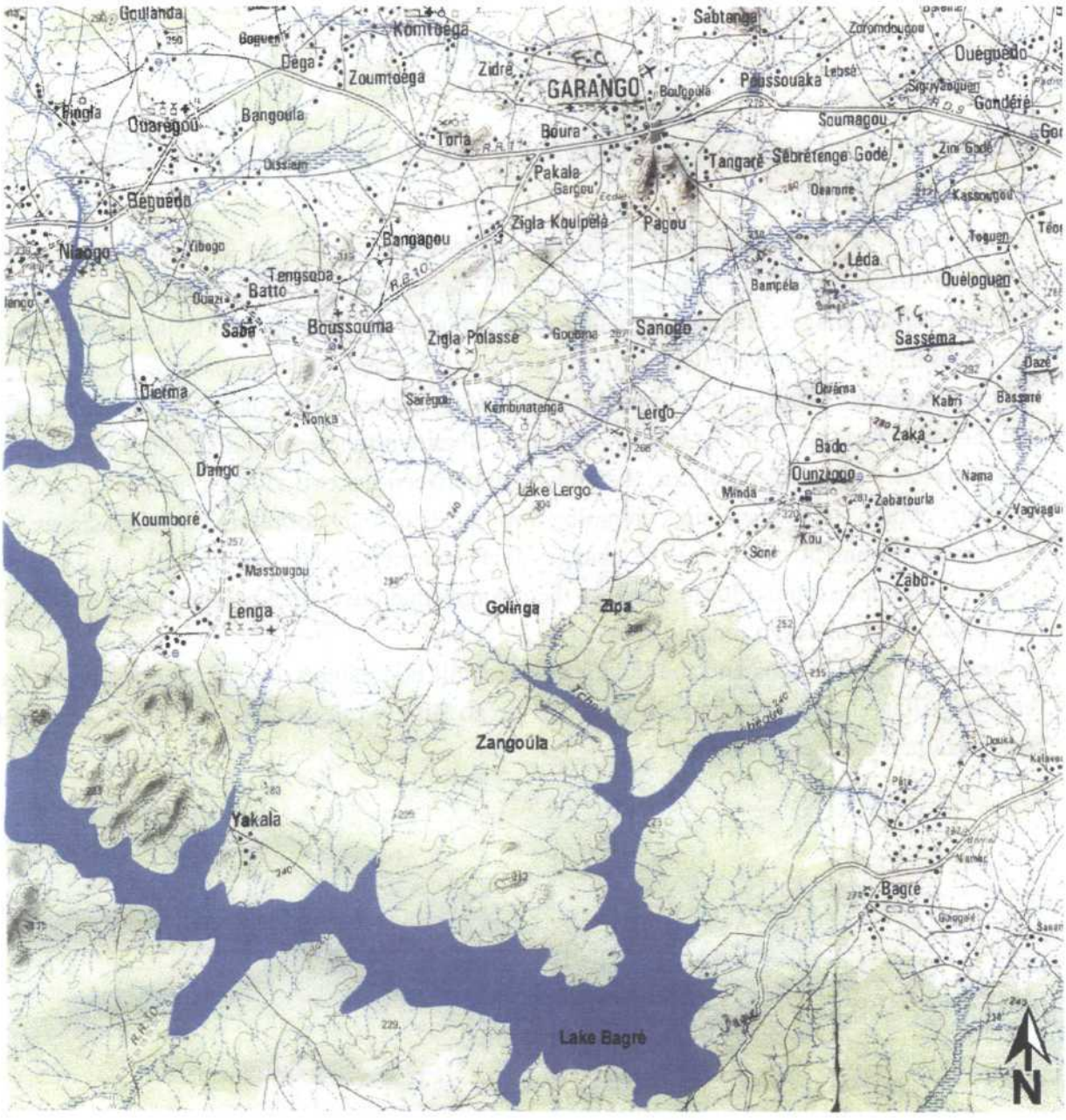


Figure 13 Map of study area

A. The Bisa villages

Sanogo is the oldest of the two neighbouring villages. According to the list of chiefs and their reign, the village was established almost 300 years ago.[59] The settlement marked the end of an

[59] The chronology of the chiefs and the early history of the village was recorded by an administration clerk in 1971 according to the memory of Daouda Zéba, a prominent citizen.

exodus from Ouagadougou over several generations initiated by a conflict over the chiefdom. As the forebears of the Sanogo villagers did not win the chiefdom, they were forced to flee. The Mossi who occupied the Sanogo area at that time apparently left the region and moved towards Tenkodogo and Zabré after the arrival of the Bisa chief and his companions. Only around half of the family chiefs interviewed knew about their historical background, indicating a somewhat limited collective memory.

The largest of the Sanogo Bisa quarters is Sanogo Centre where the family of the chief and the major service infrastructure are located, and it numbers around 100 households. The total number of inhabitants in this quarter is around 800. The other quarters are smaller, but no exact figures have been obtained. The dominant family name in Sanogo is Zeba.

Lergo is similar in structure to Sanogo. It is younger and smaller than Sanogo and is made up of 8 quarters but the population for all quarters is not known. Lergo Natenga is the oldest quarter, and Lergo Padama, which was only established around 12 years ago, the youngest. Lergo Bougla is the largest quarter with 41 households. The dominant family name is Guimko. The inhabitants of Lergo also originate from the Ouagadougou area and came for reasons similar to Sanogo. Several of the inhabitants not originating from Ouagadougou came because of forced resettlement during the Second World War.

The distance between Sanogo and Lergo is around 4 km. They are major villages in the area with respect to size and services, but are not provincial centres with state administration offices or services. They do each have a small market and a few service activities like a pharmacy, mill, school, church, and mosque that service some of the smaller villages in the immediate surroundings. They are, thus, best characterised as local centres but without any particular distinctive features. What may be different from some of the villages in the more densely populated northern parts of the department, is the presence of nearby non-cultivated areas. Especially for Lergo, the southern village, this is a condition that has some important implications.

To the east, the region has the benefit of a seasonal river that provides rather good watering opportunities for cattle in the dry season and land suitable for rice and vegetable cultivation in the depression. Apart from the depression and the river, the landscape is rather homogenous with level fields on ferruginous leached sandy to silty soils typical of the province. In the western part of the village areas is another seasonal river or stream that also provides for some rice cultivation and watering of animals on a more modest scale. In the Sanogo area there is hardly any uncultivated land left.

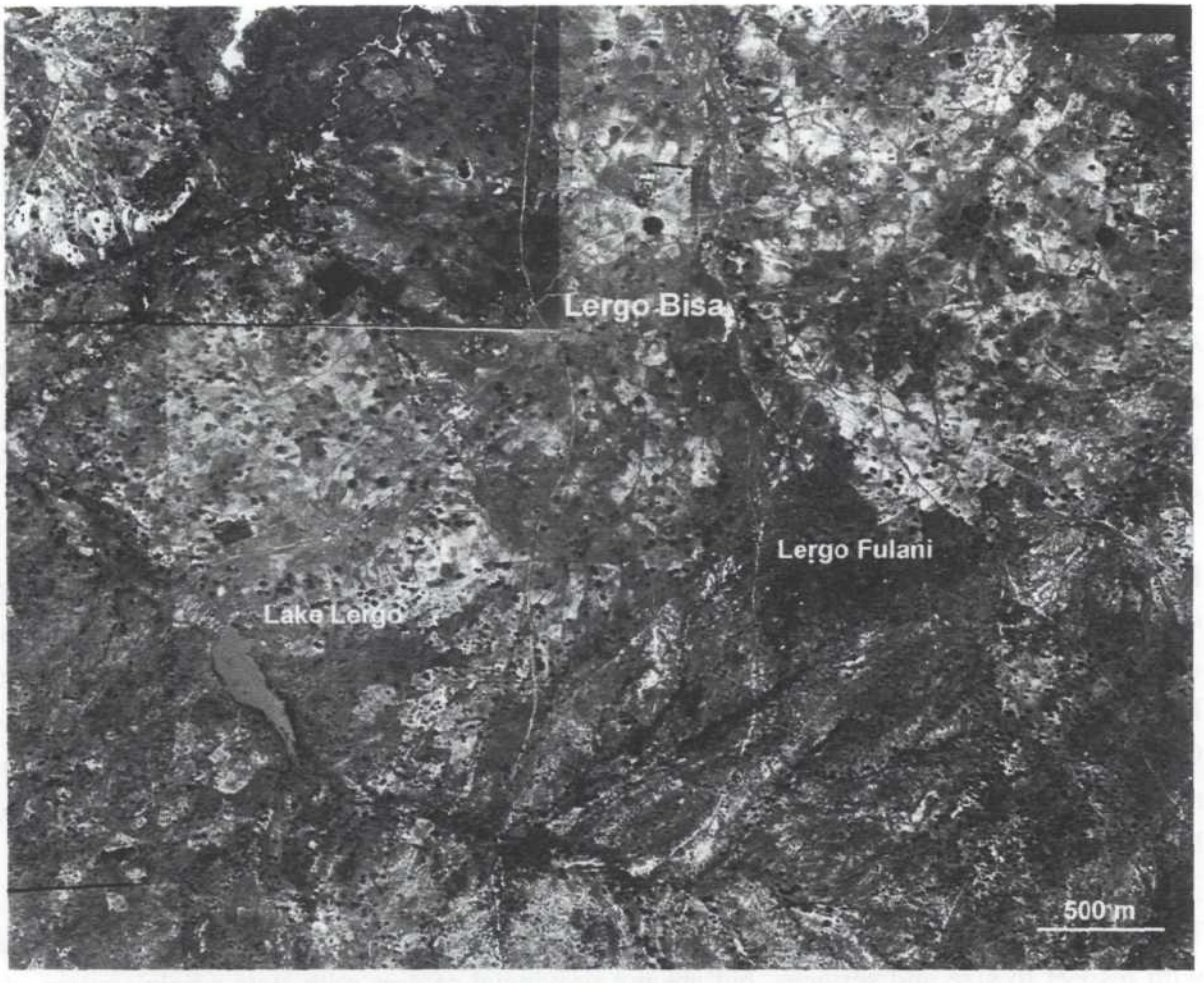


Figure 14 The area surrounding Lergo village. Aerial photo composite 1994, north up.

As can be seen from Figure 15 and Figure 16, the villages are composed of a number of farms scattered over a rather large area. The cluster of houses belonging to the chief and his closest relatives is situated close to the market and mosque, and hence forms a centre for the village. The individual households are spread out in the neighbourhood and divided into quarters or districts, each with a subordinate chief.

The households are normally surrounded by the most intensively-cultivated fields, which results in very open and spacious villages. Both Sanogo and Lergo control rather large village territories. The exact borders of the territory have not been identified. Sanogo's territory is bordered by the territory of Garango to the north, Zigla Polassé to the west, Bampéla to the east and Lergo to the south. Lergo is bordered by Ounzéogo to the east, Lake Bagré to the south and Lenga to the west. As the land adjacent to Lake Bagré is included in Lergo's territory, the village has gained some additional importance as this land may in the future benefit from irrigation. This land has, since the eradication of onchocerciasis, also typically attracted many newcomers in the growing season, which has further added to the significance of the village and its chiefdom.

Figure 15 Sanogo village centre from aerial photo 1994. North up.

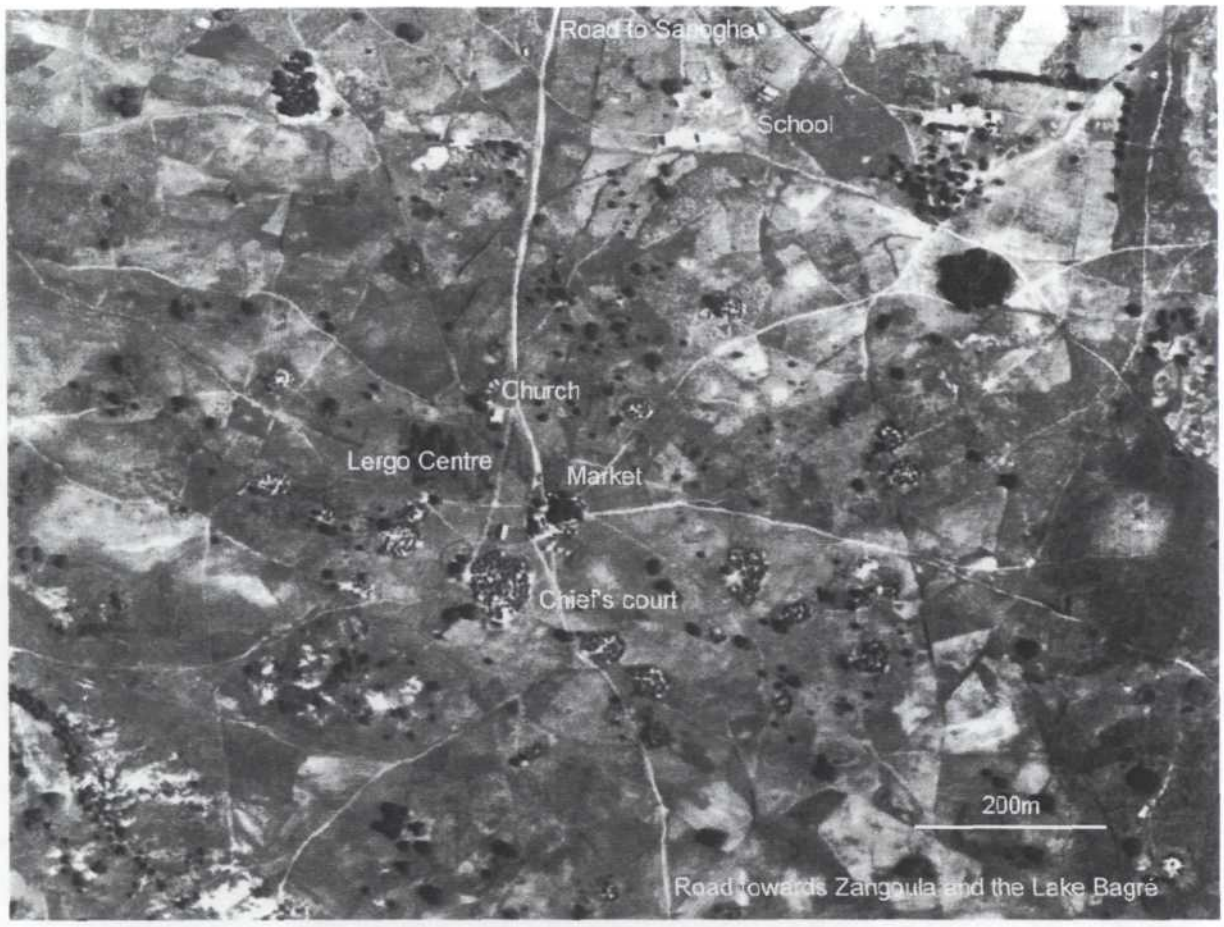


Figure 16 Lergo village centre from aerial photo 1994. North up.

Bisa is the predominant ethnic group in the two villages. The majority are Muslims, though there is an important Christian minority which runs a church in each village. The Bisa live in patrimonial nuclear families mostly made up of parents and children, however in many cases also including daughters-in-law and grandchildren. The head of the hold's siblings do not normally live in the same household. Figures from the villages show that the average family chief is 59 years old, and lives with 16,5 people in his household including 1,8 wives and 11 children. There is a minor difference between the two villages though the size of the households is almost the same. In Lergo, it seems to be more common to have siblings living in the household; around 25% did so. The corresponding figure in Sanogo was only 5%. As can be seen from the figures below, there is a difference in the number of wives among the heads of household in the two villages. Quite a large group of heads of household have two or more wives in Sanogo, while this figure is 24% lower in Lergo.

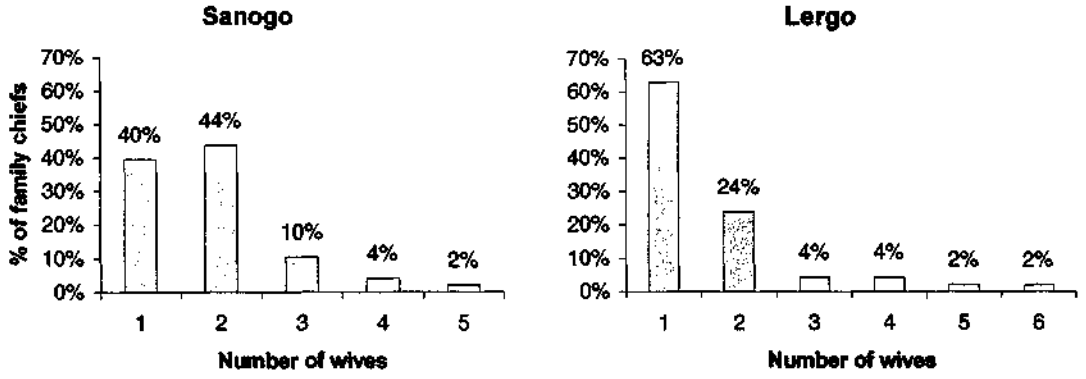


Figure 17 Number of wives among Bisa farmers in the two case villages. Sanogo n=50, Lergo n=47

As wives are commonly related to wealth, this could indicate that Sanogo farmers are more prosperous than Lergo farmers. This issue will be discussed further below.

1. Agriculture

The close proximity of the villages means that the natural resources available to them are quite similar. Yet significant differences in agricultural practices and land use can be observed. The following analysis will focus on differences in land use characteristics between the two Bisa villages, and thereby reveal some of the processes of change that are presently taking place.

a) Fields

In Sanogo, each household cultivates on average 3,1 fields, while in Lergo each cultivates 3,7 fields. In the survey, all fields belonging to a household were accumulated and no distinction was made between e.g. women's and men's fields.

Figure 18 shows what this average looks like in relative figures. Few farmers have 5 or 6 fields. The number of fields also indicates the relative size of the field, i.e. the largest is number one; the second-largest number two, etc. A field is here defined according to the farmer's own classification. This means that a field is a unit defined by the farmer and will be based on a combination of factors like location, soil-texture, topography, crops and tenure. To impose a classification onto the farmer during the interviews would not necessarily correspond to the farmer's perception of a field as a unit. Though the criteria for classification may have varied somewhat among the respondents, the classification is more consistent when based on the farmer's own criteria, as it is assumed that consensus exists at local level.

It can also be seen from Figure 18 that there is a slight difference between the two villages. There is a tendency for farmers in Lergo to have more fields than the Sanogo farmers. This may indicate that it is easier for farmers in Lergo to establish new fields because of the availability of virgin land nearby.

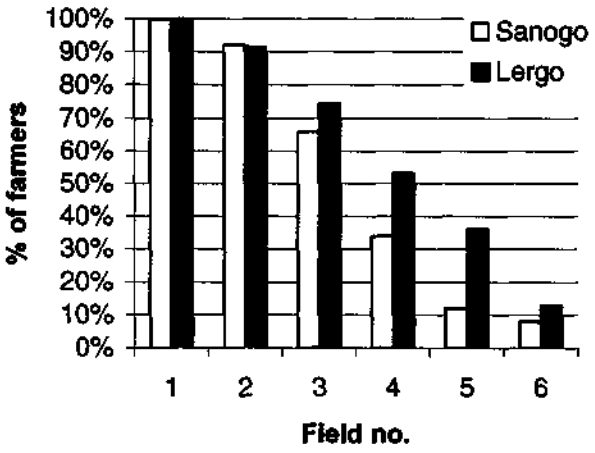


Figure 18 Fields among Bisa farmers in the two case villages. Field no. corresponds to relative size, with 1 being the largest field and 6 the smallest. n=50 in Sanogo and 47 in Lergo (see also Table 9 page 143).

This number of fields is significantly lower than what has been found in studies in other parts of the province (Mertz and Reenberg, 1999), possibly indicating better land availability than in more densely-populated areas of the province, as households do not have to spread their cultivation over many small fields when they have plenty of land available. However, as the size of a household's agricultural area is not known, it is assumed that the average acreage for a household is more or less similar in the two areas.

Most farmers have cultivated their fields for a long time. Most of the fields were inherited by their current users and have thus been cultivated for several decades. As can be seen from Figure 19, it is mostly the smaller fields in Lergo that have been cleared by the present user. There is a tendency for the smaller fields to be increasingly cleared by the farmer himself and are therefore younger, a tendency further elaborated in Figure 20. The difference between Sanogo and Lergo in the large fields may be interpreted as showing that agricultural expansion has been more pronounced in Lergo than in Sanogo in recent years. Field 6 has been left out of the figure due to too few farmers having that many fields.

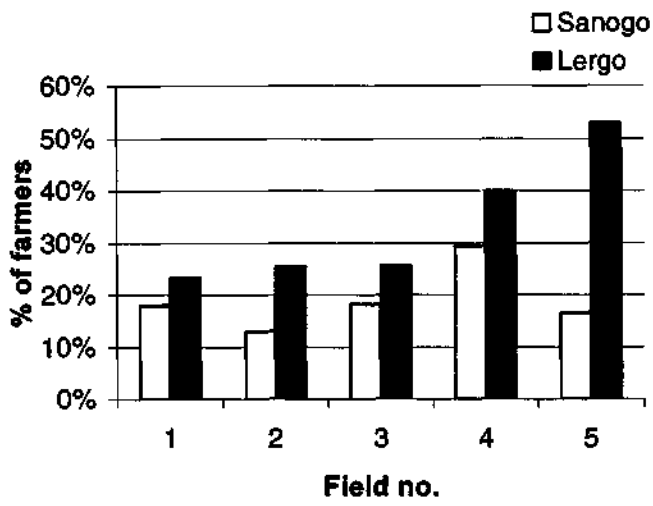


Figure 19 The percentage of farmers in each field size-group having cleared the field themselves. Field 6 has been left out. (See Table 9 page 143 for details)

Farmers only rarely reported that they had acquired new fields within the last few years. The most common reason for establishing new fields was decreasing harvests on the old fields. Reasons given for not establishing new fields were mostly connected to farmers not having the strength or labour available, or to the absence of bush-land that could be cleared. In Sanogo, 86% of the interviewed farmers reported that finding new land for establishing fields is difficult. In Lergo the corresponding figure is 63%. In both villages, the reason given is the absence of bush-land as everything is already under cultivation. Furthermore, 72% of the Sanogo farmers reported that if they establish new fields, they would do so in the Lergo territory; not only because they consider free bush-land to be available there, but also because they know the area and the people. Most of the Lergo farmers said they would establish new fields in the southern part of the Lergo territory. Not one suggested the northern regions as a possibility.

These figures strongly support a fundamental difference between the villages concerning land availability. For the study area, the south is obviously the direction to go in if new land is to be found, and the Lergo territory is still considered a potential expansion area.

This trend is confirmed by a recent study based on classification of satellite images and aerial photos divided into a 25 km^2 grid (Reenberg and Dybkjær, 1996). According to these data, the Sanogo area has a cultivation intensity of 60-64% while Lergo's slightly lower, with 50-54%. South of Lergo towards the lake, cultivation intensity falls to less than 40% but a remarkable rise in intensity can be found close to the Zangoula area at the borders of Lake Bagré (50-54%).

The age of non-inherited fields confirms the trend from Figure 19 that the Sanogo fields are older than the ones from Lergo (Figure 20 and Table 9). Even though this trend only covers recent field clearings and therefore does not reveal anything about the age of the fields in general, it does indicate that field saturation of occurred in Sanogo quite some time ago. There also seems to be a tendency, especially in Lergo, for the smallest fields also to be the youngest.

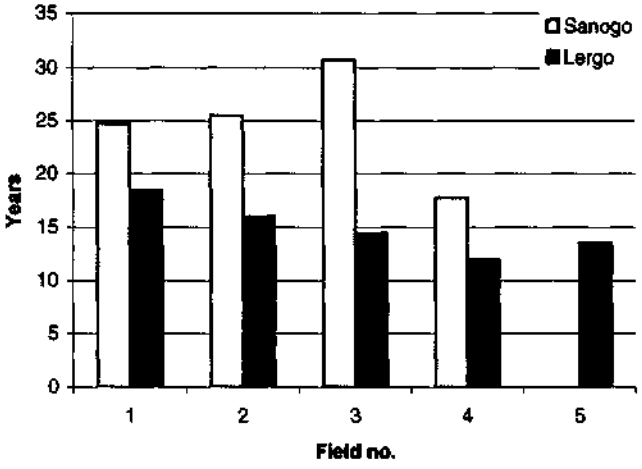


Figure 20 The average age of fields cleared by the Sanogo and Lergo farmers themselves. Inherited fields are not included. Sanogo field 5 and field 6 for both villages have been excluded (see Table 9 for details). Sanogo n=26, Lergo n=50.

As can be seen from Table 9, relatively few farmers have more than 3 fields. So few farmers have 5 and 6 fields that it is meaningless to draw conclusions based on average figures. Table 9 also illustrates the mean spread around the average (standard deviation) and the interval around the average within which there is a very high certainty of finding the actual figures (95% confidence interval). The spread and confidence interval of the ages of the fields are considerable and, coupled with the fact that relatively few farmers have cleared their fields themselves, the results must be characterised as very varied, meaning that the average figure is less likely to represent reality well and must therefore be regarded as somewhat uncertain.
No distinction was made between fields that had been cleared in Sanogo or in a neighbouring territory. For Sanogo fields in group 4, around 1/3 were established in the Lergo territory, which also indicates that virgin land has been difficult to find in Sanogo for a long time.

	Field no.	1	2	3	4	5	6
Sanogo	No. of farmers who have fields	50	46	33	17	6	4
	No. of farmers who have self-cleared fields	9	6	6	5	1	1
	Average age of self-cleared fields (A)	24,8	25,5	30,7	17,8		
	Standard deviation of A	17,7	16,9	21	21		
	95% confidence interval of A	11,6	13,5	16,8	18,4		
Lergo	No. of farmers who have fields	47	43	35	25	17	6
	No. of farmers who have self-cleared fields	11	11	9	10	9	2
	Average age of self-cleared fields (B)	18,5	16	14,4	12	13,6	
	Standard deviation of B	10,2	14,4	15	14,2	13,9	
	95% confidence interval of B	6	8,5	9,8	8,8	9,1	

Table 9 Number of farmers with different numbers of fields and the ages of self-cleared fields, with related statistics.

As mentioned, Bisa farmers often have their fields surrounding or very close to their households. This creates the open character of the villages in the region. Figure 21 shows how the fields of the farmers are located. It can be seen that around half of the largest three fields are located next to the farmers' households. The location of the fields differs in the two villages. Significantly, the largest field is more often located next to the household in Sanogo than in Lergo. Second and third fields are less significant, while smaller fields should be taken with some caution due to the limited number of fields (as a consequence hereof field 6 has been left out). None of the farmers interviewed in Sanogo had 5 fields (see also Figure 18 and Table 9). This difference between the villages regarding the largest fields helps confirm that it is easier to establish large fields further from the household as this land is naturally limited by the neighbours. That most of the Sanogo fanners have their largest field close to the household may indicate that they have to go further away to establish new, larger fields.

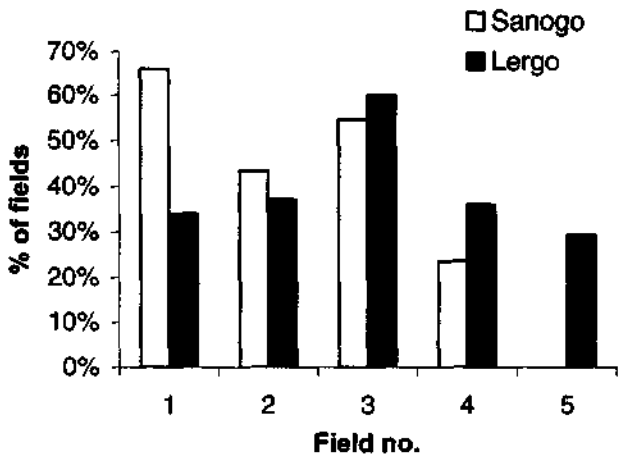


Figure 21 Fields in each size-group located next to the household. Field 6 has been excluded. Sanogo n=50, Lergo n=47

When looking at the distance to the fields, the findings shown in Figure 21 are supported. The outlying fields are, on average, around 6 and 4 km away from Sanogo and Lergo, respectively. These figures are based on the indications made by the farmers, hence they only can be regarded as tentative. However, the farmers have a good perception of distance and some broad tendencies can be deducted from the data with reasonable reliability. As shown in Figure 22, it is difficult to define a trend across the field numbers due to insufficient data. However, the second-largest field is significantly further away than the rest. As 57% of fields in this group are outlying, and as 92% of the farmers have fields of this type, it must be assumed that this is a genuine characteristic of Sanogo. In general, the outlying fields are further away in Sanogo than in Lergo, which confirms that there is very little unused arable land left within the Sanogo territory.

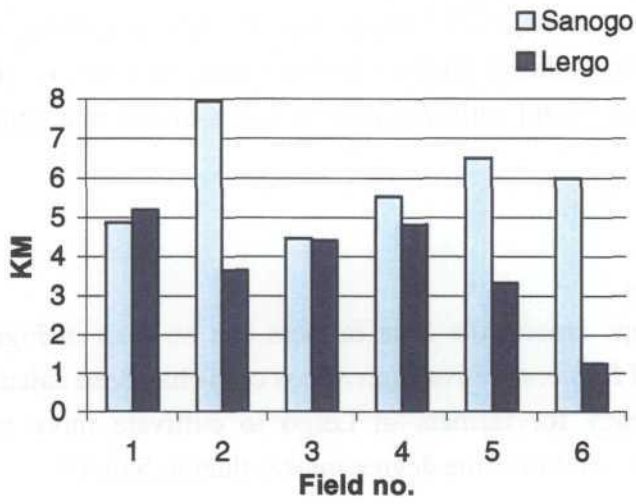


Figure 22 Average distance to fields not located next to the household. n as Figure 21.

Gardening in depressions is only practiced by 10% in Sanogo and 19% in Lergo. The most common garden crops are cabbage and lettuce but also manioc, maize, banana, onion and tomato are found, with mango trees interplanted. These fields are irrigated by shallow wells dug within the field boundary. They are situated in the depression close to the river, or in connection with small dams in the vicinity. Most of the fields were established by the farmers themselves 6 years ago on average. This activity is, therefore, relatively new, which confirms explanations given by the Fulani that unused land in the depressions is also getting harder to find.

Figure 23 Garden in depression in Sanogo. Well in the foreground.

A picture of gradual saturation of agricultural land towards the north is emerging. The area frontier seems to have been reached in Sanogo, where agricultural expansion is no longer possible, while towards the south in the Lergo territory uncultivated land can still be found. Thus, it must be assumed that it is getting increasingly more difficult for farmers in Sanogo to expand their agricultural land, either because of the sheer distance or because in the long run they may not be able to obtain tenure rights in another village territory. Following Boserup's theories, it might then be expected that the agricultural practices will be more intensive in Sanogo than in Lergo, where expansion is still possible. As discussed previously, intensification can be defined as a composite of levels

of inputs and outputs, fallow, and the technology used. The data available do not allow for a detailed investigation of the degree of intensification, but by looking at various factors like crops, harvest, fallow and animal traction a rough indication can be obtained that, together with the analyses of the Fulani villages, reveals some of the relationships discussed in the theoretical section.

b) Crops and harvest

The most common crops among the Bisa farmers can be seen in Figure 24 and Table 10, where the percentage of farmers cultivating various crops has been calculated. As can be seen, there is a slight tendency for farmers in Lergo to cultivate more traditional cash crops (groundnut, cowpea, rice, and to some degree maize) than in Sanogo.

	Red Sorghum	White Sorghum	Millet	Maize	Groundnut	Cowpea	Rice
Lergo	87%	32%	96%	38%	55%	34%	27%
Sanogo	96%	28%	94%	12%	44%	26%	22%

Table 10 Cultivation of various crops among Bisa farmers in Lergo and Sanogo Bisa. Sanogo n=50, Lergo n=47

As discussed previously, increased cash cropping is normally associated with increased intensification. However, given the rather limited sample and the modest magnitude of the differences, nothing conclusive can be deducted from this, except that there is from these figures no indication that farmers in Sanogo are intensifying more than in Lergo.

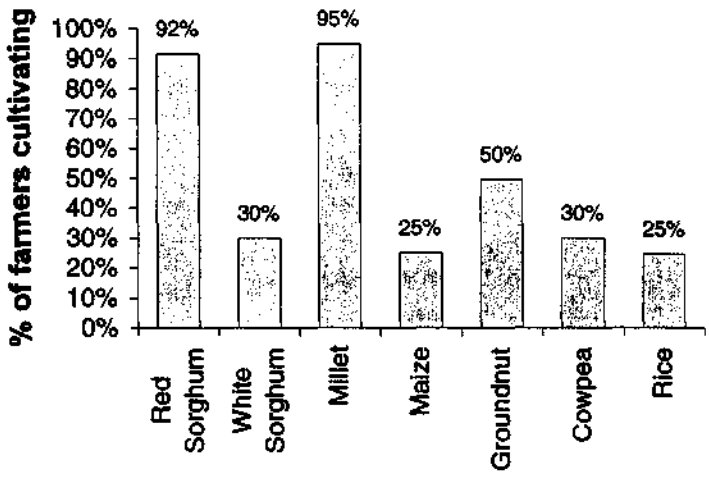


Figure 24 The cultivation of different crops among Bisa farmers as average between Sanogo and Lergo. n=50 and 47, respectively.

Red sorghum and millet are the two most important crops, cultivated by almost all farmers. Red sorghum is normally depicted as the most important crop. The taste of millet is preferred, but red sorghum has a tendency to give higher yields and also lasts longer in the household because of its inferior taste. Groundnut, cowpea and rice are frequently sold on the market and are traditionally considered cash crops although they also enter household consumption. Millet and sorghum are also sold occasionally, as will be discussed later on. Maize is normally consumed immediately by the children in the household.

There is a quite remarkable difference in preference between red sorghum and millet in Sanogo and Lergo, as is illustrated in Table 11. Lergo farmers seem to prioritise millet much higher on their two largest fields, while Sanogo farmers primarily cultivate red sorghum on their largest field, with more millet on their 2nd and 3rd fields. The figures are calculated from the occurrence of the crop in each field. As most fields are sown as mono-cultures, and as the red sorghum-millet combination is seldom used in mixed cropping fields in the villages, this method should give a reasonable indication of the farmers' priorities. Of course, the area covered by each crop is not taken into consideration except in relative terms, which may distort the result, but not completely set off the significant difference depicted.
The reason for this difference could be that if Lergo farmers are better off than Sanogo farmers, as it is reasonable to assume that better-off farmers would prioritise millet over red sor-

ghum because of its superior taste. However, a match of the supposedly better-off farmers[60] against crop preferences did not show any correlation. The analysis presented on the previous pages does not support this hypothesis either.

	Largest field		Second-largest field		Third-largest field	
	Red sorghum	Millet	Red sorghum	Millet	Red sorghum	Millet
Sanogo	64%	42%	21%	65%	15%	48%
Lergo	30%	70%	30%	60%	48%	8%

Table 11 Preference ofmillet and red sorghum among Bisafarmers in Sanogo and Lergo. Calculated as percentage of farmers who cultivate the two crops in their three largestfields. No acreage ofindividual crops is included. Sanogo n=50, Lergo n=47

Though the Lergo fanners may not be better off than the Sanogo farmers, this may indicate that their agricultural situation is more favourable. In Lergo, the largest fields are younger (see Figure 19 and Figure 20) hence the fertility of the fields is probably better, hence the farmers may be in a generally better situation and can thus rely more on the better-tasting millet. It is also possible that this could be an indication that the supply of manure is not sufficient in Sanogo for the farmers to be able to compensate for the infertility of the soil. However, manure is seldom used on millet directly and as none of the farmers buy manure from the Fulani and seem to have little understanding of the relevance of this particular question, lack of manure is not recognised as a very serious problem by Bisa farmers. On the other hand, as is shown below, the installation of cattle on the fields is much more prevalent in Lergo than in Sanogo, so soil fertility may yet hold some of the explanation.

c) Management and agricultural practices

Manure is almost exclusively used on red sorghum. In Sanogo, 81% of the farmers used manure on red sorghum while only 8% reported using it on millet. In Lergo, the corresponding figures are 89% and 5%. The manure, which primarily consists of household waste and in some cases animal dung, is seldom transported on carts to distant fields. It is almost exclusively used on the fields next to the household.

The animals of the Fulani are, to a varying degree, installed on the fields of the Bisa farmers. In Sanogo, 23%, and in Lergo, 79% of the farmers reported that Fulani animals stayed on their fields. They normally enter the fields after the harvest and stay for a few months or the rest of

[60] Households with more than 3 cattle or 5 sheep or 7 goats and 2 or more wives. These criteria are based partly on the market price of animals from Table 6, page 112, and an overview of the farmers' livestock in order to get a relatively small fraction of the farmers. This rather crude wealth classification is solely used in this specific evaluation and does not constitute the basis for further analysis.

the dry season. Only a few of the herds are installed in night pens, where the most important and concentrated dung application occurs. Thus the nutrient contribution is of random and varying importance.

The fields that receive grazing cattle are chosen out of location rather than through a conscious choice by the owner of the fields. The farmers of Sanogo often explained that this has to do with high demands for payment from the Fulani, but none of the Sanogo farmers who have had animals on their fields actually paid for the installation. In Lergo, the most common explanation for not having animals installed on their fields was that the fields are too distant from watering points or simply that they are out of luck. In Sanogo, it is usually the same herder who comes with his cattle year after year. In Lergo, this is often not the case as the herders can come from a number of different villages in no specific repetitive pattern.
The different prevalence of animal installations on the fields between the villages will be dealt with later in connection with the analysis of the Fulani communities, but this might suggest that a closer relationship exists between the two ethnic and functional groups in Lergo than in Sanogo. This could be explained by the more massive presence of animals in Lergo as the animals have been moved out of the Sanogo territory. It may also indicate that the process leading to the emigration of the herders and their animals is characterised by conflicts that damage the relationship between the groups and increase the social distance between them. The Sanogo farmers' claim that the Fulani demand payment for the installation of the animals may be seen as indicative that this alienation has not yet having taken place in Lergo, at least to the same degree.

Fertiliser is used by 16% of the farmers in Sanogo and 30% of the farmers in Lergo. This moderate usage was put down to lack of money and knowledge of correct usage. The fertiliser is used in the gardens, on the rice fields, on the fields with millet, but less on sorghum.

Fallow is used by 24% of the interviewed fanners in Sanogo and 38% of the interviewed farmers in Lergo. 46% of the Sanogo farmers reported that they have never used fallow and in Lergo this figure is 55%. The fact that fallowing is more widespread in Lergo than in Sanogo could be related to the circumstance that Lergo farmers in general have more and newer fields that could have been established on more marginal land. On average, the fields have lain fallow for 6 years in Sanogo and 10 years in Lergo. These figures are in accordance with Boserup's hypothesis about the relationship between pressure on land and the shortening of the fallow period. In this way, the fallow practices confirm the picture of more pressure on land in Sanogo than in Lergo.

The above figures point to an agricultural system where fertility management in the form of nutrient recycling and fallow is only practiced extensively. Most of the fields have been used continuously for many years and the application of manure is determined by immediate avail-

ability and costs of transportation. Thus, the majority of fields are dependent on household waste, the plant residues left after the harvest (especially from nitrogen fixating crops like cowpea and groundnut), dung from occasional stubble grazing animals, and the nutrients deposited in dust transported by the Harmattan winds (Harris, 1996:10). The yield from the fields is therefore likely to converge towards a low-level steady state where water and labour availability will be the most significant determinants for a given year's yield.
This tendency is confirmed by a study in a village in the same province, but situated in a more densely-populated area, where a negative correlation was found between the years of usage of the fields and the fertility of the soil as classified by the farmers (Reenberg, 1997:16).

The harvest collected by the Bisa households during the 1996 season is illustrated in Figure 25. 1996 was characterised as a normal year by most of the farmers, and the precipitation was close to the average since 1980. The millet harvest was larger than that of red sorghum, but may still be consistent with the farmers' perception of red sorghum as their most important crop as it lasts longer in the household. The difference between the two villages in harvest figures is insignificant, hence the figures have not been separated. However, between the households there are very large differences (up to factor 50 in extreme cases and a standard deviation as high as the average). Considering the variation in household sizes, this is hardly surprising and the household size and subsistence production do correspond well with a correlation of 0,65 for Sanogo and 0,56 for Lergo.[61]
The maize harvest is so small that it has not been included. It is normally cultivated for immediate consumption primarily by children, and does not represent a significant contribution to household subsistence.

Only the total harvest for each crop is known. There are no data for the individual fields and no yield per hectare can be calculated. The data have been obtained through interviews and are based on the farmers' own estimates in various measures. Hence the data cannot be regarded as exact, but merely as an estimate.[62]

[61] With n=50 and 47 this gives high certainty of correlation with a significance level of less than 0,05%.
[62] Conversions used: 1 sac of peeled grain of 100kg corresponds to 40 "tasses". 1 "tasse" equals 2,5kg. 1 "tinne" equals 7 "tasses", i.e. 17,5kg. 1 cart full of unpeeled sorghum or millet equals 100kg. The cartload is an estimate, but the conversion factor has little influence on the results as it is only used in few cases.

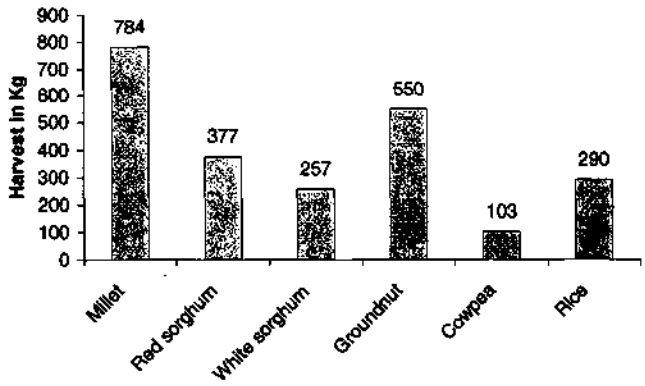


Figure 25 Average harvests of common crops 1996 among Bisa households in Sanogo and Lergo villages. n=97

The households are normally not self-sufficient in cereals. For the 1996-97 dry season, 90% of the farmers in Sanogo and 66% in Lergo did not consider the harvest to be sufficient. A calculation of the number of persons the harvest could theoretically support compared with the number of household members, does point to a consistent grain deficit in the households of the same magnitude in both villages. On average, the households have 16,5 members and produce enough food, including what are traditionally considered cash crops, for the yearly consumption of 7,5 persons. This results in an average deficit per household of the yearly need of 9 persons.[63]

In order to cover this grain deficit approximately 2/3 of the farmers in both villages reported having bought food-grain in 1996. On average, the farmers interviewed bought 153 kg which corresponds to at least CFA15.000 (1996 prices), or roughly the value of three sheep. This was financed through savings, from the selling of animals, from credit or from children working in domestic towns or in the coastal countries. It must be noted that this amount of bought cereals does not make up for the deficit calculated for the average households. Given the large spread in these average figures, there could be many factors that could explain this difference. The most likely reasons are probably inaccuracies in the size of households as this may vary with season because of emigrational work etc., inaccuracies in the harvest figures, other sources of food like gifts, hunting, collection etc., and inaccuracies in the amount of cereals bought, as this is likely to be on an ad hoc basis and in small quantities.

[63] All crops except maize, which is negligible, are included, as the selling of crops is not confined to traditional cash crops like peanut and cowpea. The yearly need per person is estimated at 190kg, irrespective of crop type and age group. This is the consumption estimate used by the Burkina Faso statistical office and must therefore be regarded as locally adapted (Direction des Statistiques Agro-pastorales, Ministere de l'Agriculture et des Ressources Animales, Ouagadougou, Burkina Faso). One especially large household in each village was left out of the calculation in order to get a more representative picture. Their influence on the average however, was less than 10%.

Only 16% of the farmers interviewed in both villages reported having sold crops. Half of the fanners had sold groundnut, but other crops were also sold to varying degrees. The modest commercialisation of crops that does take place is, thus, not confined to the traditional cash-crops, groundnut and cowpea.

Labour migration is common in both villages. In Sanogo, 62% of the farmers reported having relatives working outside the village on a more or less permanent basis, while the same figure for Lergo was 42%. In 71% of the cases, the destination was Côte d'Ivoire, and by far the majority had settled permanently and only returned irregularly on visits.

2. Animal husbandry

Animal husbandry for traction and for other purposes is rather widespread among the Bisa farmers. There are, however, large differences between the two villages, as animals are much more prevalent among the Lergo farmers. Figure 26 shows that 26% of the Sanogo farmers interviewed have cattle, while in Lergo the corresponding figure is 40%.
Small-stock (goats, sheep) dominate in Lergo, but are much less widespread in Sanogo. None of the fanners have pigs, and horses are seldom found. The largest differences between the two villages are with goats, sheep and donkeys. The relatively high number of farmers with donkeys in Lergo could be explained with reference to Figure 21, page 144, where it was shown that the Lergo fanners have more fields than the Sanogo fanners. As these fields are normally located at some distance from the household, this may explain the extra need for donkeys as they are primarily used in connection with the cart for transport of the harvest etc. 21% of the fanners in Lergo own a cart while the conesponding figure for Sanogo is only 8% which corresponds well with the difference described above.

From Figure 27 can be seen that although a smaller portion of the Sanogo farmers have animals compared to the farmers of Lergo, those who do have animals have more. This is the case for all animals except donkeys for which there is no significant difference. This could indicate that farmers in the wealthiest fraction in Sanogo are better-off than corresponding farmers in Lergo.

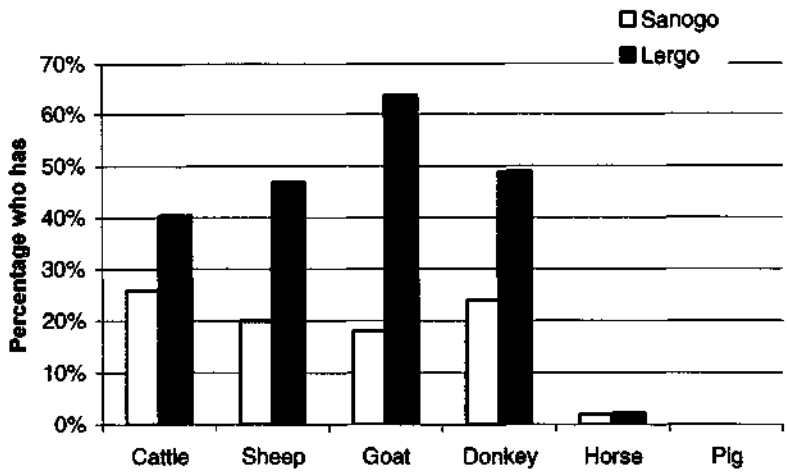


Figure 26 Prevalence of animal ownership among Bisa farmers, Sanogo n=50, Lergo n=47

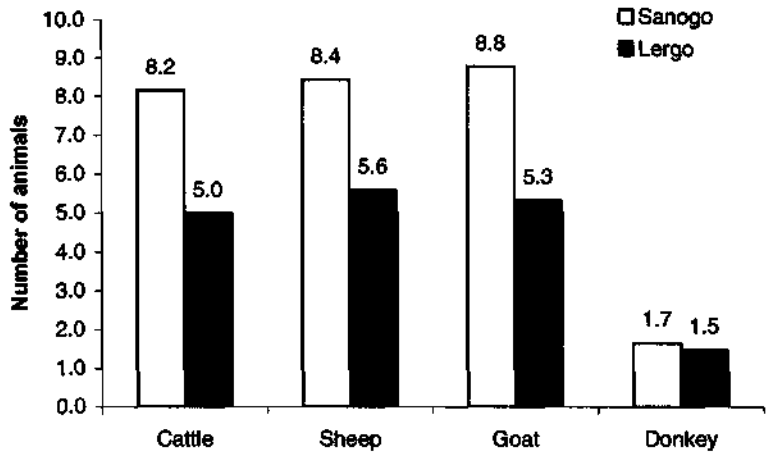


Figure 27 Average herd size among Bisa farmers owning animals. Horse has been left out because of too few occurrences. Sanogo n=50, Lergo n=47

The use of draught animals is widespread in both villages, however, again with some significant differences which can be observed in Table 12. The use of draught animals is more widespread in Lergo than in Sanogo. More farmers in Lergo own draught animals and more draught animal users own the animals themselves, though the Sanogo farmers are again the

ones with larger herds. For both villages, there is a high correlation between ownership of cattle and draught animals, and the draught animals make up around half of the cattle population in the Bisa villages indicating that draft power is the main motivation for having animals among Bisa farmers. However, it is more common to keep cattle for other purposes than draught in Lergo than in Sanogo which points to a more diverse animal husbandry in Lergo which may be related to the entrustment system, as will be discussed later.

	Sanogo	Lergo
tf-anriers whause cfraugirt animals	**44%**	55%
Fanners who own draught animals	**30%**	**40%**
Farmers using draught animals who own them	**68%**	73%
Average no. of draught animals	**3,9**	**2,4**
Farmer cattle owners who own draught animals	100%	95%
Farmer cattle owners where all cattle is for draught	**69%**	39%
^Jtøujht anirnajsaspartjjftotal farrner cattje	**53%**	54%

Table 12 Draught animals in Bisafarmer herds. Sanogo n=50, Lergo n=47

The draught animals are most often oxen around 3-4 years old. In both villages, the farmers started using the draught animals some 6 years ago on average, however, a significant number of farmers (42% of the cattle owners) kept cattle before this time. The big plough used for soil preparation is the most commonly used tool and is owned by around 2/3 of the farmers who use draught animals.

Around 43% of the draught animal users in both villages had other people to work as paid labourers on their fields, either as single input or in combination with their own animals.
The slightly higher number of farmers using draught animals in their cultivation in Lergo could support the hypothesis that more expansion is going on in Lergo as the introduction of the plough is usually accompanied by an enlargement of the field. This was reported by the vast majority of farmers (all in Sanogo and 68% in Lergo). As will be shown later, entrustment arrangements are also more prevalent in Lergo, which facilitates cattle and draught animal ownership and may partly explain the differences in animal husbandry between the two villages.

Data of this sort can be delicate to deal with. The number of animals is directly related to wealth and the respondent must therefore be expected to be reluctant to give a precise number. However, as described in the methodology section, much attention was given to this point. The farmers were, in general, not reluctant to answer questions concerning their herds, and the degree of secrecy among the farmers is questionable as it is rather difficult to hide the ownership of large animals like cattle is a small, close-knit society like the ones described here. There is no reason to suspect that the comparison between the villages should not be reliable, as the relative figures should not be affected by inaccurate absolute figures, i.e. there is no

reason to believe that the farmers of one village should be more inaccurate than in the neighbouring village.

Looking at similar studies in the region may mitigate some of uncertainty surrounding these delicate data. The number of farmers owning cattle corresponds well with the findings of Delgado from 1976-77 (Delgado 1979a: 176) from the Bisa village Loanga close to Tenkodogo (approx. 20 km distance from Lergo/Sanogo). In this study, it was found that around one third of the Bisa households owned cattle and that the average herd size was 4 animals. As shown in Figure 27, this herd size is somewhat less that present data indicate, for which several explanations could be given. The Sanogo/Lergo area is more convenient for livestock rearing, as it is a less populated and urbanised environment. This could also have the effect that the farmers living close to the province centre, Tenkodogo, have more ample possibilities for alternative urban-based investments of the surplus that would otherwise have been invested in cattle. However, as stated by Delgado (1979a: 179), Bisa and especially Mossi farmers were not enthusiastic about revealing the size of their herds, a factor further accentuated by the fact that farmers at that time were being taxed per head of cattle. This would be expected to make the farmer more hesitant in revealing to outsiders, and thereby possibly the authorities, the true extent of his wealth. This could lead to an underestimation of the number of animals in the older studies.

Since 1976, the profitability of having cattle has risen partly due to the devaluation, as explained in the previous section, which may also have increased the cattle holding among Bisa farmers. However, as the most recent data are from 1989 and as the strong increase in cattle prior to this year must at least partly be ascribed to pastoralist immigration (see section VI.C, page 110), nothing conclusive can be deduced from the available statistics.

The majority of the farmers of Sanogo and Lergo indicated a negative trend during recent years in their animal stock, including small-stock. This was especially evident for Lergo. The key reason given for the decline was diseases of various kinds, although in Lergo a few of the farmers also mentioned theft.

However, some farmers have increased their herds. In Sanogo, the main reason for an augmentation of the animal stock was better care and vaccination, while in Lergo the augmentation was ascribed to an increased awareness of the benefits of keeping animals.

However, these data should be treated with some caution, as they may be influenced by the farmer's wish not to leave an impression of doing too well. As will be discussed later, the Fulani all maintain that the Bisa farmers have increased their herds because of the need for draft power and the price increases. Moreover, local extension staff share the impression that the Bisa have increased their herds.[64] Although, of course, the statements of the Bisa cannot just

[64] Personal communication with Pierre O. Sayoré, Director SPRA, Tenkodogo; Joseph Sorbegou, Encadreur/Veterinary, Bagre; Théophile Faho, Director Projet PDR/Boulgou, Tenkodogo;

be disregarded it would be reasonable to assume that some increase in the Bisa herds has taken place.

Most Bisa farmers keep cattle because they can be used in crop cultivation. Draft power for the plough is the main reason, given by around 90% of the farmers, but also supply of manure is mentioned by around one third (Sanogo farmers to a lesser extent, however). Almost *VA* of the cattle owners mentioned savings and economic reserves that could be capitalised in case of urgent need as a reason for having cattle. However, more than two thirds of the farmers exclusively mentioned crop cultivation and so this must be regarded as the dominating motivation for having cattle. Thus, for the Bisa farmer cattle represent an active investment used to support their main activity, crop cultivation. The difference between the two villages is insignificant. Keeping cattle for milk is very rare among the Bisa.

The reason for not having animals was almost exclusively lack of money. A few of the farmers put it as a choice between either many children or cattle, as children are so costly that there is no surplus for animals. Only one out of 65 farmers in the two villages who does not own cattle mentioned the difficulties associated with managing cattle as a reason for not having any, while just one other farmer mentioned avoidance of conflicts over trespassing animals as a reason. Several of the farmers stated that cattle rearing in general was a good thing and that they would do it had they only the means to do so.

The composition of the Bisa farmers' cattle herds confirms that animal traction is the primary purpose for having cattle, according to the farmers. The average percentage of female cows in the herds is 25% for Lergo and 20% for Sanogo, thus indicating male-dominated herds as would be typical for animals kept primarily for traction purposes. 42% of cattle owners in Sanogo and 46% in Lergo did not have any cows in their herds. This differs from the Delgado study (1979a: 175-180) where the majority of the herd were females and the cattle were described as an investment rather than being used for traction in crop cultivation. This is also in sharp contrast with the Fulani herds as, will be discussed later. None of the Bisa kept dairy cows.

The age structure of the Bisa cattle shown for Lergo village in Table 13 also confirms this difference, as the male cattle are older than would have been expected had the cattle been raised for sale (typically sold at the age of 4 (Delgado, 1979a: 175)). It does, however, also confirm the tendency for female cattle to be kept longest, which was also a finding in the Delgado study (Ibid.). This suggests that productive females are kept for the longest time, and that the majority of males are sold at a younger age than the females for economic benefit, but that they are still kept longer than would be explained by the commercialisation of cattle alone.

Age	0-2 years	3-4 years	5-6 years	Over 6 years
Number Males	7	24	21	3
% Males	13%	44%	38%	5%
Number Females	1	8	8	5
% Females	5%	36%	36%	23%

Table 13 Total cattle herd age structure among Bisafarmers interviewed in Lergo (n=47).

The cattle that have not been entrusted to Fulani (to be dealt with later) are guarded by the young boys of the family. It is normal practice for the farmer to collect fodder for the animals. The leaves of the peanut and the stems from the white sorghum are the main fodder. A few of the farmers collect and dry grasses. Cultivation of fodder was not reported. The animals are kept close to the household. They are tied within or close to the compound or are guarded in the fields or in small patches of forest in the vicinity.

In general, grazing land was perceived of as being difficult to find. In Sanogo especially this was seen as a severe constraint, as almost all the farmers who own cattle expressed this concern. Only one cattle owner did not see it as a problem. In Lergo, the picture is somewhat more diffuse. For 15 out of 19 cattle owners in Lergo, finding grazing land was a problem. 13 farmers (including non-cattle owners) did not see it as a problem, but only 4 of those owned cattle. As it must be assumed that it is the actual owners of cattle who would have the best information concerning the availability of grazing land, it must be concluded that grazing land, also in Lergo, is a limited commodity. The simple reason given by almost all fanners was that there is no more unused land left, and that this was primarily a problem during the rainy season. However, a few of the farmers in Lergo also mentioned the Fulani as being the direct cause of the problem, as they do not allow the Bisa herds to graze the available land. This is an indication of some of the animosities between these two groups, which will also be discussed later.

3. *Summary*

The Bisa villages show significant differences. Uncultivated land is more readily available in Lergo than in Sanogo, which is also reflected in the fact that fields are younger in Lergo compared to Sanogo. Sanogo is now densely cultivated, while Lergo still has some unused arable land left to the south. Animal husbandry is more prevalent among Lergo Bisa farmers than among Sanogo ditto, although the size of the herds indicates a more wealthy population in Sanogo, which is also supported by some demographic data. The livestock in Lergo help maintain the fertility of the fields, which may account for the significantly higher degree of cereal self-sufficiency in Lergo. Draught animals are also more widespread in Lergo, which may indicate active agricultural expansion.

Except for less prevalent and shorter fallow periods, there is no indication that the saturation of land that has taken place in Sanogo has led to more intensified land use, as would be expected following the Boserupian hypothesis of autonomous agricultural intensification. On the contrary, there are indications that cash cropping, animal traction, fertiliser use and self-sufficiency are more prevalent in Lergo. These factors would be expected to be more prevalent in Sanogo where the area frontier has been reached and the fallow practice diminished. Instead, migration is much more prevalent here, which could indicate that the farmers of Sanogo are not able to intensify their agricultural production and therefore have to look for alternative sources of income. Thus, the two Bisa villages reveal a picture that seems to go against the Boserupian development model. As discussed in the theoretical section this could be related to the complementary links between the Bisa farmers and the Fulani pastoralists through the expansion paradox. The following section will look into the Fulani households and their relationship to the Bisa farmers.

B. The Fulani settlements

The lifestyle of the Fulani varies significantly with their environment. In the arid Sahel, the Fulani have to adopt a very mobile and flexible lifestyle, while in the Soudanian zone, where the precipitation and hence the biological production is more stable, they gradually adopt a de facto sedentary lifestyle. In the study area, this includes the construction of stationary clay-huts, the cultivation of permanent fields, the maintenance of stable relations with Bisa farmers, and the possession of usufruct rights to the natural resources in the village territory to which they belong. The Fulani in the study area are therefore not to be characterised as nomads, and even pastoralist may be a dubious term as a substantial part of their subsistence needs are derived from the cultivation of sorghum and millet. What makes them different from the Bisa fanners is their cultural identity, their marginality in relation to village society and hence their political power, and their preference for animal husbandry. They conceive of themselves as primarily livestock-, and especially cattle-keepers, and will normally strive towards optimising herd management without demurring at the expense of crop cultivation.

However, living a largely sedentary lifestyle does not mean that mobility is not an important aspect of their livelihood strategy. The maintenance of an animal flock composed of goats, sheep, and cattle in all age groups and for different purposes and with several owners, demands flexibility and considerable experience. Though the climate is relatively favourable towards animal husbandry compared to the Sahelian regions, the pronounced seasonality of the rain and the widespread cultivation induce radical changes in the availability of fodder and water over the seasons, thus necessitating a high degree of mobility and flexibility. The herder is therefore forced to adopt an opportunistic grazing strategy and adapt to the possibilities offered by the season, which include moving the herd to where the best resources may be found or where fields are less of a hindrance.

The following section describes the grazing pattern of the Fulani in the area, and shows how these patterns have changed in recent years, leading to long-term changes in the Fulani settlements. These changes may be seen as symptoms of more far-reaching trends concerning the marginal political and social situation of the Fulani. As for the Bisa villages, the two Fulani villages are interpreted as being under the influence of the same processes that, through conflicts, lead to the further marginalisation of the Fulani with negative consequences for the feasibility of animal husbandry in the region either for the Bisa farmer or the Fulani pastoralist.

1. Basic description

The Fulani settlements, Sanogo Fulani and Lergo Fulani, are the main objects of the study. They cannot be seen as isolated from the Bisa villages. They are separate entities, but at the same time they are also a unit. Administrative decisions and the settlement of disputes etc. take place in the court of the Bisa chief who is the local chief, also for the Fulani. However, the Fulani do have influence on the decisions taken and this influence is far from negligible.

The Sanogo Fulani and Lergo Fulani settlements are small compared to the Bisa villages. Thus, aggregate data used for the description of the Bisa villages cannot be used to the same degree for the Fulani settlements. In the following, aggregate data will therefore only be used cautiously, while more emphasis will be put on individual cases.

All Sanogo and Lergo Fulani households that have distinct herds and were available have been interviewed. The number of respondents is 10 for Sanogo Fulani and 11 for Lergo Fulani. In Lergo Fulani, this is only 65% of the households, as several of the households managed their herds together with a brother or a parent who lived in a neighbouring household. Some households were selected for repeated interviews. Most of these repeated interviews were held in Lergo Fulani. All interviews were conducted by the author with the help of an interpreter.

The Sanogo Fulani use the school and the pharmacy in Sanogo Bisa, but they have their own well, mosque, Koran school, and a pump under construction. There is no mill. The village consists of 11 distinct households, mainly the Diao family and a few Sondé and Bandé. Sanogo Fulani is the oldest Fulani settlement in the area and was apparently established at the same time as Sanogo Bisa. They originally came from the Fada n'Gourma area, where a dispute over cattle forced them to move. Although they arrived around the same time as the Bisa, they had no connections prior to this time.

The chief of the Fulani (the Djiorro) lives in Sanogo Fulani and is also the head of the Fulani settlements in the vicinity, including Lergo. He inherited the position from his father, but was replaced by a village representative and a CDR (Comité pour la Defence de la Révolution) during the Sankara revolution. Later on, he was reinstated, and today his duties are to attend official meetings and act as official contact person for the Fulani in the area. Until taxes on animals were abandoned, tax collection was also one of his duties.

Figure 28 Fulani household

After Sanogo Fulani, the oldest of the Fulani settlements is Lergo Fulani (17 households). Thereafter come Zarma (6 households) and Turkuma (10 households). Gala (11 households) is an offspring of Turkuma and is around 15 years old, while the newest, Zangoula (24 households), is only around 10 years old and is still not really considered a village but rather a new settlement close to the borders of lake Bagré. This village is also partly included in the analysis as it has close relations to Sanogo and Lergo Fulani.

Lergo Fulani is, like Sanogo Fulani, situated in the vicinity of the Bisa village. Lergo Fulani consists of the families Bandé, Géandé, Barri and Sondé and is, as such, more diverse than Sanogo. Although there are some family ties between Sanogo Fulani and Lergo Fulani, the villages are composed of distinct families and are therefore also distinct units. In Lergo Fulani, most of the inhabitants originate from areas close to or from Sanogo Fulani. Some have been there for generations, while most have been there for less time than was indicated in Sanogo Fulani.

The infrastructure in Lergo Fulani is quite limited. There is a well and a waterhole in which there is water throughout most of the year. Otherwise, all the services needed are found in Lergo Bisa Village. The households consist of 1-5 huts made of clay with tethered roofs. The courtyard is open, though sometimes sheltered by woven straw mats or branches. There are generally more huts in the Sanogo Fulani households (average 5,7) than in Lergo Fulani (average 3), while the average number of persons living in the households was for both villages 11-12 persons, including children. The Fulani sometimes live in extended families with parents, brothers/sisters or nephews. A few of the households in Sanogo Fulani have brick houses with corrugated iron roofing.

In Sanogo Fulani, there does not seem to be a single dominant cause for settling. Some settled there because of conflicts over inheritance or because of lack of land in Fada n'Gourma. In

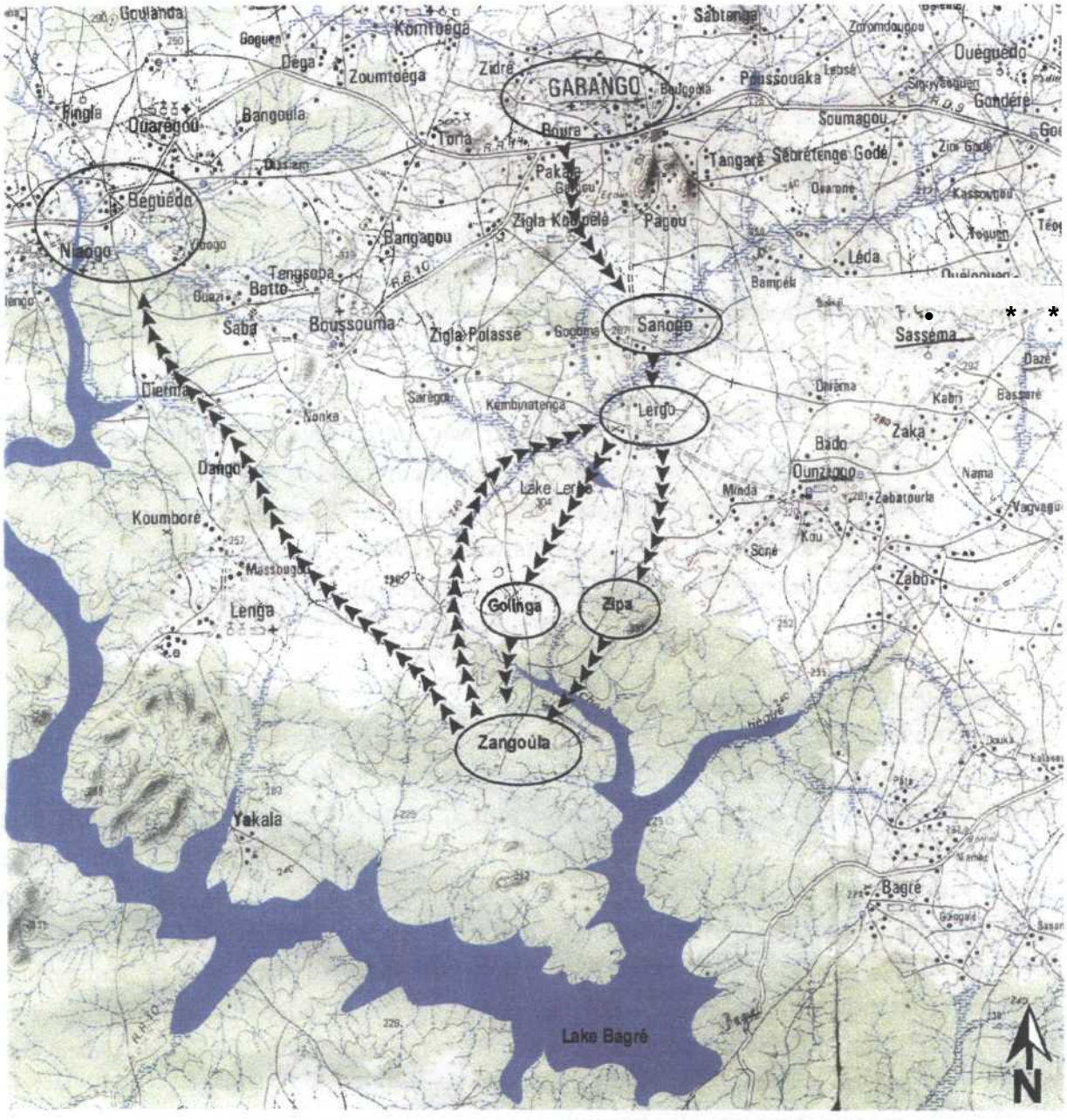
Lergo Fulani, almost the sole reason given for settling in Lergo was the density of fields in their place of origin.

The average age of the Lergo Fulani heads of household is 44 years. They have 1,5 wives and 7 children. There is a tendency for the head of household in Sanogo Fulani to be older than in Lergo Fulani, their average age being 53 years. They also tend to have more wives, in Sanogo Fulani 55% of the heads of households have more than one wife, while the corresponding figure in Lergo Fulani is 44%. These simple demographic data to some degree confirm that Sanogo Fulani is a settlement to a large extent populated by older people whose children have settled elsewhere with the family herds.

Long-distance economic migration by the Fulani was not covered in the study as the focus was on the use of the local resources and animal husbandry, and as external financial sources were not mentioned as important. Almost all the Fulani in the area owned sizeable herds, and would therefore not be forced to do migrational work. However, a certain change of mentality may be taking place among the younger Fulani, as is dealt with in chapter 5, page 171.

2. Recent settlement patterns of the Fulani

The Fulani villages have been characterised by significant changes during the last 20-25 years. A general shift of location from the north towards the south has taken place. From the area around Garango to the north, the Fulani have moved towards Sanogo Fulani, and from here towards Lergo Fulani. Most of the households in Lergo Fulani originate from the Sanogo area. Of the Fulani living in Lergo Fulani 8 out of 12 had come from the Sanogo area or northern areas close to Sanogo. This move dates back from 5 till 37 years, averaging 17 years.
The reason given for settling in Lergo was closely related to the difficulties of herding in a crowded environment. Families from Sanogo Fulani have also moved further south towards Golinda, and from Golinda towards Zangoula close to the borders of Lake Bagré. Others settled in the area close to Zipa for around 8 years. They moved from Zipa to Zangoula in the late 1980's as the grazing there was also becoming too scarce because of cultivation.



Source map: IGN Tenkodogo NC-30XXIV, 1:200.000, Paris 1980
Lake Bagré and Lake Lergo added

2 km

Figure 29 Settlement pattern ofSanogo and Lergo Fulani

In Sanogo, most adult children and herds have moved to the southern areas. All the households remaining in Sanogo Fulani have children in Zangoula, which is a relatively large area covering a section of the northern shores of Lake Bagré. This is a relatively new Fulani settlement. The distance from Sanogo Fulani is around 20 km, which corresponds to around 5 hours walking. Access to the area is difficult even in the dry season for anything on wheels. Of the 24 Fulani households to be found here, 20 originate from Sanogo. The settlement

started here around 1982, that is, before the lake was created by the Bagré hydroelectric dam, because of good grazing and cultivation possibilities. The Fulani in this area are now also experiencing difficulties in finding adequate grazing land because of agricultural expansion.

After the creation of Lake Bagré and the eradication of onchocerciasis, many farmers have established fields in this area, albeit without permanent settlement. The first migration of Fulani away from Zangoula has already taken place because of these increasing difficulties. Some have moved to a forested area near Niaogho some 30 km to the Northwest, which is a special area that has been left more or less unused for some time because of an armed conflict between the two villages close by,[65] while others have moved back to Lergo as they find that they stand a better chance in conflicts over damaged crops when they have known the Bisa for a long time, and as they have animals entrusted to them in several cases. In Zangoula, they have no affiliation with the farmers, hence the conflicts become harder to solve.

Agricultural expansion in the Zangoula area is accelerated by the establishment of the lake which has attracted new farmers on a seasonal basis and people who want to make a claim for land with good irrigation possibilities close to the lake that may become more valuable as a result of agricultural development programmes.

The Fulani are trying to establish a pastoral zone in the hope that this will keep agricultural expansion away in at least a part of the area. They have created an association based in Bagré that fights for this zone, but in 1997 nothing conclusive had yet happened. Meanwhile, agricultural expansion continues, and for each field that is established, the more difficult it will be to have them removed again to make way for a reserved area.

The southward resettlement of the Fulani due to agricultural expansion was also observed in the Tenkodogo area in the 1970's, when several Fulani were driven off their land thirty kilometres to the south (Delgado, 1979a: 154). At that time, the agricultural frontier had not progressed as far south as is the case today.

[65] In 1983, a dispute between the neighbouring villages of Beguedo and Niaogho over access to agricultural land resulted in 5 deaths and more than 30 wounded. The area is extremely densely populated (more than 500 persons/km^2) and borders the Nakambe river where an important and intensive cultivation of onions has become a big economic activity. This land, together with a vast area of bush, is controlled by Niaogho, while Beguedo controls one of the biggest agricultural markets in the country on the other side of the river. The farmers of Beguedo, who did not have access to much bush land for cultivation, acquired tractors which opened up for an accelerated agricultural expansion in the vast Niaogho territories which eventually led to an armed conflict. As part of the peace agreement between the villages, part of the area was put under jurisdiction of the Ministry of Justice (Faure, 1990: 348-376).

Thus, agricultural expansion in the region has had a large and direct impact on the lives of the Fulani as they are continuously forced to move further and further away from their original settlements, which in many cases has led to families splitting up as the older individuals often stay behind while the young settle elsewhere with the animals. Agricultural expansion in this area is, therefore, not just a question of transforming land into fields that before was used for other purposes like hunting etc. in the same land use system as perceived by Boserup. Here it leads to the forced migration of a socio-cultural group carrying out a specific economic activity.

3. *Land-use*

The Fulani live a settled life with many links to the Bisa communities. They have fields with sorghum, millet, and maize cultivated annually, though fewer than the Bisa. Around half of the Fulani families have only one field close to the household. Only very few families have more than two fields. Most of the fields are located around or close to the households. The crops on the largest field are red sorghum, millet, some maize and some beans. On the second field, the Fulani generally cultivate white sorghum and millet.

Crops are seldom sold and 68% of the Fulani had a harvest that would accommodate the needs of the household. There are several reasons why some Fulani were not self-sufficient in cereals (3 in Sanogo and 3 in Lergo). Two rich Fulani with many cattle could afford not to bother so much about crop cultivation and instead concentrated on cattle. Two with relatively small herds mostly consisting of entrusted animals, lacked the manpower in the field. Two were poor and had little man-power at their disposal. In general, this indicates a much higher degree of self-sufficiency among the Fulani when compared to their Bisa neighbours.

Figure 30 Fulani with his millet harvest

The Fulani seldom use fallow. The fields are all well fertilised with manure from the animals, which may explain the relatively high grain self-sufficiency of the Fulani, which has also been found in a study from northern Benin (de Haan *et al,* 1990:59). Typically, manuring is done by moving the night pen around on the fields. The manure is seldom sold, but is in some cases given to the Bisa farmer for free or in exchange for services such as ploughing. The manure is primarily applied to the red sorghum and the maize and to a limited extent to the millet. Inorganic fertiliser is not used.

Draught animals are used by around 70% of the Fulani, but only around half of these families own a plough themselves. Those who do not own a plough have others to do the ploughing for

them. Mostly they do not pay for this service as it is often part of the entnistment agreement. Most of the Fulani were of the opinion that the use of the plough also led to an expansion of the fields. As animal traction is normally associated with a sedentary lifestyle, the widespread use of animal traction among the local Fulani underscores their sedentary livelihood (McMillan *et al,* 1993:90).

None of the Fulani have gardens with fruit-trees or irrigated crops. Only few of the Fulani are engaged in migrant or other off-farm work.

4. Animal husbandry

The Fulani herds number, on average, almost 40 head of cattle, 18 goats, and 11 sheep in both villages.[66] Horses and donkeys were found in only one case. As can be seen in Table 14, this average conceals a significant spread as herd sizes varies from around 100 to 0 which is reflected in high standard deviations. As mentioned, the reliability of the data has to be taken into consideration, however, especially for Lergo, where many of the herds were observed directly, the data are considered a reliable minimum estimate. Minimum, because it is expected that the respondent will under- rather than over-estimate the herd sizes for reasons discussed in the methodology section. Even with these precautions, the data indicate a much larger reliance on animals compared to the Bisa, which would also be expected.

[66] In the Bisa villages, much attention was given to the reliability of these data. As the data from the Fulani stem from repeated semi-structured interviews over several months, it was possible in many cases to verify the given figures with actual observation. Much effort was also made to triangulate the information both with respect to respondents and methods. Serious inaccuracies have not been detected, though the data should still only be seen as indicative.

Sanogo Fulani

Household	Cattle	Dairy Cattle	Sheep	Goat	Horse	Donkey
1	1		0	10	0	0
2	27	6	6	9	0	0
3	40	7	25	20	0	0
4	19	3	12	10	0	0
5	20	4	10	7	0	0
6	100	25	7	10	0	0
7	16	4	17	17	0	0
8	30	3	20	6	0	0
9	80		40	40	0	0
Total	333	52	137	129	0	0
Composition	56%	16%*)	23%	22%	0%	0%
Average	37,0	7.4	15,2	14.3	0,0	0.0
Std.dev.	32.3	7.9	12.0	10.6	0.0	0,0

Lergo Fulani

Household	Cattle	Dairy Cattle	Sheep	Goat	Horse	Donkey
1	50	12	30	20	0	0
2	0	0	3	4	0	0
3	46	7	6	6	0	0
4	54	6	10	7		
5	20	3	10	5	1	1
6	34	5	17	6	0	0
7	24	5	16	6	0	0
8	55	13	30	9	0	0
9	48	5	39	10	0	0
10	23	3	4	3	0	0
11	47	6	20	25	0	0
12	70	20	40	36	0	0
Total	471	85	225	137	1	1
Composition	56%	18%*)	27%	16%	0%	0%
Average	39,3	7,1	18,8	11.4	0,1	0,1
Std. Dev.	19,4	5,4	13,2	10,2	0.3	0,3

*Table 14 Herd size data for Sanogo and Lergo Fulani. * as percentage of cattle only*

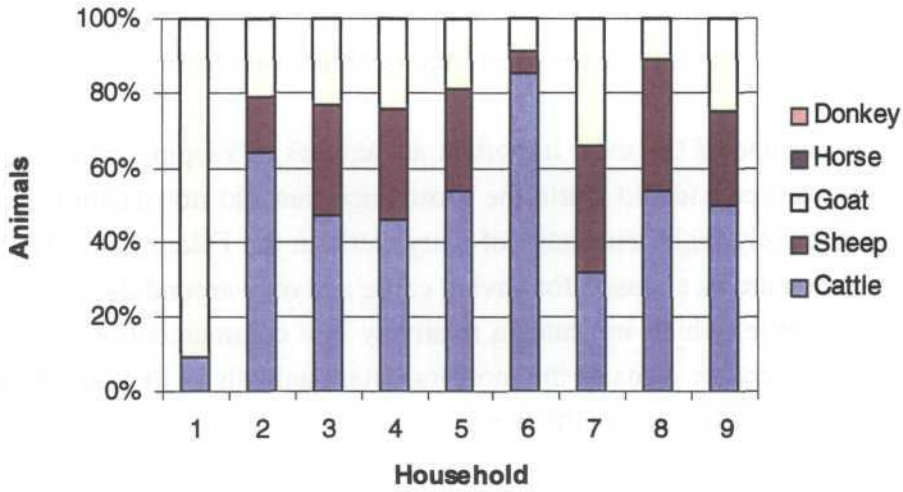


Figure 31 Species composition of Fulani herds in Sanogo

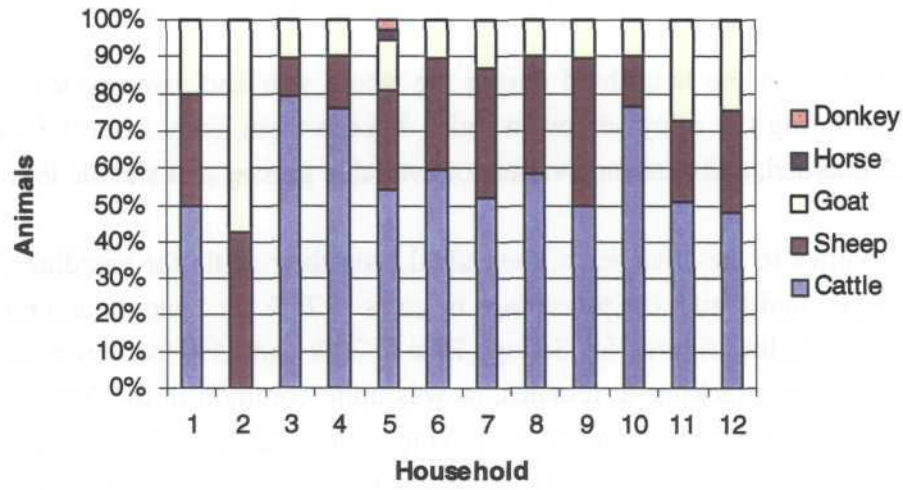


Figure 32 Species composition of Fulani herds in Lergo

Figure 31 and Figure 32 show the species composition of the Fulani herds in Sanogo and Lergo Fulani. On average, cattle constitute around 56% of the herds, goats make up 25%, and sheep 19%. As can be seen in Table 14, these figures are almost identical for the two villages. However, the percentage figures may conceal the importance of cattle, as the households with high percentages of goats and sheep are also the poorest households with few animals altogether. This can be observed by comparing the above figures with Table 14 where e.g. household 1 and 7 in Sanogo and household 2 in Lergo have relatively low percentages of cattle but at the same time are also the households with fewest animals. These figures therefore empha-

size the importance of cattle compared to other species, as more wealthy Fulani prefer a high percentage of cattle in their herds. This is, furthermore, confirmed by the interviews, as almost all Fulani consider the cattle to be the most important domestic animal.

Milk is considered one of the most important advantages of keeping cattle and only 1 out of 17 respondents who considered cattle the most important did not mention milk. This is reflected in the relatively high percentage of dairy cattle in the Fulani herds. Half of the Fulani also mentioned manure as a reason for having cattle and only around 24% mentioned the high market value of cattle, which indicates a relatively low commercialisation of cattle. Only 3 Fulani mentioned sheep or goats as the most important animals as they breed fast and thereby are a possibility for building up a cattle herd.

Typically, the sheep follow the cattle in the rainy season and separate night pens are built for them close to the cattle night pen. They are kept close to the household during the dry season, sometimes guarded by the youngest children. Water is found at Lake Lergo at the beginning of the dry season, and later on at small permanent or temporary wells. They feed on dry grasses in the forests, leaves of the groundnut but not the stems, and later, if necessary, on cut branches of *Acacia sieberiana.* During the onset of the rains they may follow the cattle in pursuit of the first rain.
The goats are kept at the household during the whole year and given water here. The adult goats are tied during the rainy season in order to keep them away from the crops. They are normally not guarded, and feed on a variety of available grasses and stubble leaves.

As a sharp contrast to the Bisa herds, the Fulani keep their cattle for breeding rather than for traction. In the Fulani herds, the percentage of cows is 76% for Sanogo, and 66%for Lergo,[67] while the corresponding figures for Sanogo Bisa is 20% and 25% for Lergo. None of the Fulani herds are entirely lacking in females, as was quite common in the Bisa herds (42% and 46%, page 156). Draught animals do, on average, only make up 7% in Sanogo and 5% in Lergo of the Fulani cattle herds. This figure is, however, based on very few occurrences, hence the percentage of draught animals of the total number of cattle in the Fulani herds is more reliable. For Sanogo, only 1% of the Fulani cattle herds consist of the Fulani's draught animals, while in Lergo it is 2%. However, the actual share of draught animals in the Fulani herds is bigger, as they include some of the draught animals of the Bisa farmers that have been entrusted to the Fulani. The few Fulani households who have draught animals all have two.

[67] Figures are based on an average percentage in each herd with a small spread (standard dev. 5 and 6 respectively). The percentage of total Fulani animals has not been used because of missing data on the number of cows for some households.

Because of the large number of animals in the Fulani herds there are no detailed data on the age structure of the herds. The text boxes present two progeny histories of selected cows. These cases may serve as illustrations of typical herd management among the Fulani in the

Progeny history 1:
10 years and oldest cow in a herd of 27 cattle of which 20 are cows and 25 are owned by 4 Bisa farmers. It was bought by the herder at the age of 1 and he intends to keep it until its teeth are all worn down. At the present age if turn butchering for 45.000CFA. The cow never aborted.

1st Calf was born at the age of 3. A male that died from snakebite when 3 months old. The father was sold at the age of 9 in 1991 for 50.000CFA (before devaluation If the CFA) at the Garango Market.

2nd Calf was born at the age of 5. A female that died after 6 months from a disease. The father was a bull from a neighbouring herd that by chance had mingled with the herd as there was no large bull in this herd. The following year the cow did not calve because of disease.

3rd Calf was born at the age of 7. A female that will be three years old in the coming rainy season. The father was a random bull from another herd. The owner is going to keep the heifer which will be covered in the coming rainy season (1997).

The year after the third calf the cow did not become pregnant for no apparent reason. In the 1996-97 dry season the cow was pregnant again with a random bull from Lergo.

area. More general statements show a rather mixed picture, with many older and younger specimens kept together. As the herds are kept primarily for breeding it might be expected that the bull would be sold of at a relatively young age, but in the herds many older male cattle are also found. This could be explained by the high degree of draught animals among the entrusted cattle, as draught animals are typically 4-5 years old when they are bought for draft power. It could also be partly due to a preference for older cattle that have proven their endurance and fertility (Delgado, 1979b:69). In some cases, the draught animals are used for around two years and then sold as they become too tired for such hard work. The cows in the herds are preferred to be young, as they are most productive. They are normally covered at the age of three and calve at the age of four in the early rainy season. The dairy cattle are mostly 5-6 years of age, but cows aged up to 17 years were encountered which indicates a desire to maximise milk output

Progeny history 2:
of 70 head are cows and ID are owned by 4 Bisa farmers.

1st Calf at the age of 4 but died at birth.

2nd Calf at the age of 5 in the rainy season. A female that will be covered in the rainy season 1997 at the age of 3. The father was sold at the harvest 1995 at the age of 7 for 105.000CFA.

Calf at the age of 6 at the time of the first female sold at the age of 1 for 40.000CFA in order to buy various necessaries. Father the same as for the second calf.

4th Calf born at the age of 7 in the rainy season. A male that died three days later. The father was a 7 years old bull born in the herd, and had now become the dominating bull.

In October 1996 the cow was covered again with the same bull and was expected to calve in the early rainy season 1997.

from the herds, as also noted by the Delgado study in the same province (Delgado, 1979b:69). The cows can calve every year, but quite often they only succeed every second year, apparently due to malnutrition or disease. Selective breeding is not performed; the bull used for covering is normally chosen according to availability, as is also illustrated in the progeny histories in the textboxes.

As mentioned, milk is one of the most important incentives for the Fulani to keep cattle. Besides entering their own home consumption, sour milk and butter is sold by the Fulani women at the local Bisa markets in the rainy season. However, almost all Fulani complain that milk production has decreased significantly during the last 8-10 years. The reason given by all Fulani was that it has become more difficult to find enough and good grazing land due to agricultural expansion and the burning of fields and bush. During the long dry season almost no milk can be extracted from the cows. As discussed previously, milk is the major benefit the herder gains from taking animals in entrustment, and a decline in milk production may therefore negatively influence the herders willingness to enter entrustment arrangements. Thus, agricultural expansion, to the extent that it can be blamed for declining milk yields, also has a negative effect on the possibilities for exploiting complementary links between farmer and pastoralists, in this case by jeopardising the conditions for entrustment.

6 out of 22 Fulani had increased their herds in recent years either because of having sold only few animals or because they had taken more Bisa cattle in entrustment. All 6 are from Lergo. The rest (and the majority) stated that they had less now compared to before. The main reason for this was various diseases that killed the cattle despite vaccinations. Several also blamed the decreasing availability of fodder and some blamed the young Fulani for being more interested in selling the cattle than taking care of them.
32% of the Fulani had sold cattle in 1996 and half of the Fulani had sold animals, if sheep and goats are included. The animals sold were well mixed in sex and age, but no young females were sold, as the basic principle is to sell the young males or old unproductive cows and buy young females. This principle is only abandoned in situations of acute need e.g. in connection with illness. Only 4 Fulani (18%) had bought animals in 1996 and, except for one horse, all were young cows.

The sale is not confined to a specific season where e.g. the prices are at their highest but is determined by the immediate needs of the family. Among the Fulani there was no consensus as to the seasonally of prices. However, a small majority was of the opinion that cattle prices are generally highest during the rainy season as they are in the best condition at this time and as there is a demand for draught animals. In the dry season, prices are lowest as the animals are in bad condition. Several mentioned that the outcome of the harvest was important for cattle prices, as a good harvest means higher demand and therefore higher cattle prices. That

there is so little consensus indicates that prices may be dependent on unpredictable variables like climate, present demand for draught animals etc.
Short-term fattening of animals, e.g. sheep, is not common. The animals should be fattened for around half a year during the rainy season, but in general feed is considered too expensive, labour demand is too high, and the risk of disease is also too high.

5. *A changed rationality among the young Fulani?*

It is a common perception among local extension staff and national support agencies that the animal husbandry of the farmers is more intensive (i.e. feeding with cut grasses and gathered crop residue demanding more labour) compared to the pastoralists, and also that they are more market oriented.[68] A perception somewhat along the lines of the "cattle complex" narrative discussed previously (page 83). Unfortunately, the present study cannot provide detailed data on the age structure of the pastoralist herds, which could indicate the degree of market involvement, and as discussed on the previous pages the notion that the Fulani are more concerned with building up a herd than transforming it into another asset cannot be rejected. It may, therefore, not be altogether wrong that the farmers are more involved in the animal market thus their animal husbandry is more beneficial to Burkina Faso due to export earnings. However, to the degree that this picture is true there may be a change of attitude occurring towards the management of animal husbandry especially among the young Fulani, which will be discussed in the following.

It may not be surprising to see a change in the economic rationality of young Fulani (both male and female). It is well known that early contact with Europeans and the introduction of Western-type education led to the emergence of a more individualistic attitude to work and remuneration and hence a gradual breakdown of tribal solidarity (Boserup, 1965:91). With today's widespread use especially of the radio and to some extent the television, young Fulani are constantly being influenced by urban and more Western or global lifestyles. The young Fulani are keen market participants. This is where things happen and young Fulani hanging around the bars enjoying soft drinks and contemporary music from ghetto blasters is a common sight on market days. Bicycles, or even better mopeds, are "hot" and fancy clothes in local style are as important here as among teenagers everywhere. Posters on the walls, visits to the big cities, narratives of returning migrants who have been to the coastal and richer and consumer-oriented societies, all add up to a far from isolated way of life. Wants, which their parents did not know of or were not much influenced by, are now common. It is hardly unrealistic therefore, to expect a change in the way the young Fulani regard their parents' stocking of animals. Numerous were the complaints of the parents that the young Fulani just wanted to

[68] Personal communication with Pierre O. Sayoré, Director SPRA, Tenkodogo; Gustave Dabillougu, Encadreur/Veterinary Garango; Joseph Sorbegou, Encadreur/Veterinary Bagré.

sell the animals in order to buy consumer goods. See textbox for the opinion of a couple of Fulani heads of household.

Opinions of two Fulani

" The young like clothes, food and money in their pocket. When I was young my father gave me clothes. The young are less responsible now. They are bad herders. "

"I don't know why it has changed with the young. They just want to sell the animals, but don't care for work. They want to buy a moped instead. But as they cannot read or write they can't make it in the city so they stay here. Two of my kids went to school; one for 5 years and one for college, but he didn't finish, so now the others don't care for it either. "

This, however, does not mean that the young Fulani will sell all their animals, join the modern worshippers of mass-consumption in large cities, and give up their parents' way of life. Even if they wanted to, city life may not be a feasible option for the relatively un-educated and often illiterate young Fulani. Besides, they are experts at their metier and with the increased prices and growing demand for meat following the rapid urbanisation, the Fulani may, in fact, be in a strong economic position, giving them little incentive to give up their pastoral way of life. Interviews with young Fulani who were very active in the markets buying and selling animals did not show less responsibility toward the needs of the family and the notion of security. Animals were not sold unless there was a specific need.

For a Fulani, wealth is equivalent to cattle. The notion of wealth is closely related to the characteristics of the herd. It is alive, it reproduces itself, it moves, and care has to be taken that it is allowed to reproduce under the best possible conditions. To dispose of your cattle would be to undermine your own wealth, which is why selling cattle is associated with bad behaviour, shame and loss of social status (Riesman, 1990:328). These cultural values can be traced back to the Fulanis' past as a noble warrior class who used the Rimaibe as slaves. This cultural heritage is without doubt important for the Fulani also today, but the effect of several years of contact with modern mass-media cannot be ignored. Though the basic values may be intact, a new, more consumer-oriented mentality is strong among the young Fulani, which may help illustrate that the "cattle complex" narrative may originate from valid observations, but that it is too narrow and simplistic in its characterisation of the pastoralist rationale.

With the elevated value of the animals, and a more consumer-oriented mentality among the new Fulani generation, it is likely that animal husbandry increasingly will become integrated into the market economy.

6. *Summary*

The proceeding pages have shown how Fulani animal husbandry differs from Bisa fanners' animal husbandry. The Fulani rely much more heavily on animals, especially cattle that are highly appreciated because of their milk, manure and high value. The composition of the herds shows that the cattle are kept for breeding rather than traction, and that draught animals constitute only a tiny fraction of the Fulani cattle. Despite vaccination programs, it is mainly

disease that has led to a falling trend in animal husbandry for the majority of the Fulani. Also, milk production has declined in recent years, smething which is blamed on the decline in available good pastures caused by the agricultural expansion. The Fulani sell off the animals when needed, and do not exploit a specific market strategy as prices are apparently quite unpredictable. However, the commercialisation of animal husbandry does take place, as the selling of unproductive and purchase of productive animals is common. Though breeding among the Bisa farmers may be more intensive and market oriented, there may be a change of mentality among the young Fulani towards a higher degree of commercialisation of animal husbandry.

7. Grazing pattern

The typical cattle grazing pattern differs in the two villages. The following will describe the individual grazing patterns of the two villages, illustrating the consequences that the different degree of agricultural expansion in Sanogo and Lergo Bisa has had for the animal husbandry. The general grazing pattern is summarised in Figure 35, page 178.

a) ftanogo Fulani

In Sanogo the herds of cattle typically only stay in the village area after the harvest in October where they graze on the leaves of the stems and the stubble on the fields. Only a few smaller herds stay here during the dry season as some of the fields and the bush are burnt. The vast majority of the herds move to the Zangoula area for the dry season where more unburned bush and fields are available. The water from the lake is used for the cattle until later in the dry season when the quality deteriorates.

With the advent of the first rains, usually in April, the Sanogo Fulani often follow the rains by moving the herds to the areas that receive rain first. Rainfall is very erratic at this time with regard to magnitude, frequency, and geographical distribution. This is the period of the longest transhumance as the search for new grazing may bring the herds 20-30 km away from the households. In a study in a village close to Tenkodogo it was noted that this transhumance could be up to 60 km (Delgado, 1979b:30; Delgado and Mclntire, 1982:190).

Figure 33 Animals feeding on crop residue

During the rainy season proper, the herds are normally kept well away from the Sanogo area for the most part in the area between Lergo and Lake Bagré, as this is the time when the risk

of divagation into fields and hence demand for payment of compensation for damaged crops is at its highest. The expansion of fields has made it more difficult for the herders to keep the hungry animals away form the fields, and the cattle corridors that are used by the Fulani to navigate through the mosaic of fields are sometimes cut or narrowed too much by new fields established by farmers who do not respect the agreements with the Fulani on keeping them open. The cattle corridors have been reduced from 4 to 2 in Sanogo during the last 20 years. Only one herder is still trying to stay behind depending on how much land he can find available, but the year prior to the research (1996) he was also forced to move, in this case to Lergo (see Sanogo case 2 in textbox).

When the decision of where the animals should graze in the rainy season is to be taken, the need for labour in the fields is an important factor, mentioned by around 1/3 of the Fulani. There is an unfortunate coincidence bewteen the forced migration of the herds and the need for labour in the fields. Therefore, the Fulani can find himself in the dilemma of trying to keep his herds close to the household at the risk of large compensation payments, or permanently moving away to establish new fields in an area where his herds can be kept in the vicinity and the manpower used for work in the fields. The last option is what almost all the families in Sanogo have chosen, and today Sanogo Fulani largely consists of old people with just a few milking cows kept close to the household.

All Fulani in Sanogo stated that the present grazing pattern developed 20-30 years ago. Prior to this, they kept their animals close to the households in Sanogo for most of the year and managed, in the rainy season, to keep the animals in the forests which still existed at that time, especially in the depressions close to the village. The sole reason given for the change was the expansion of the fields. Lake Bagré was not mentioned as contributing to the changed grazing pattern except inasmuch as agricultural expansion in the Zangoula area can be ascribed to the creation of the lake. This could be the case e.g. if it had led to expectations that future irrigation schemes would raise the value of the land, thereby encouraging farmers to establish fields where they could claim the usufruct right.

Sanogo case 1: Fulani with 20 cattle and none entrusted. Adult children live permanently in Zangoula.

Post-harvest: The cattle graze on the fields by Sanogo for around 1 month. Thereafter to Zangoula because of burned fields in Sanogo. In Zangoula they graze in the fields and in small forests. A night pen is made on their own fields, and the cattle have to be protected from hyenas. Water is obtained from the depressions and wells.

Dry season: The cattle stay in Zangoula and mostly graze the Bisa farmers' fields as the forests are used up. Would prefer Sanogo as the water is better, but the bushfires in the depressions force them away. A night pen is made after the harvest. Water is obtained from the lake, but it is not considered good quality.

First rain: Follow the first rain. In 94 they stayed at Zangoula, in 95 at Ouambako 13 km north of Sanogo, in 96 towards Léré around 28km SE of Sanogo. A night pen is made in small forests if sowing has begun. Water is obtained from small temporary creeks and waterholes.

Rainy season: Because of the many fields in Zangoula they go towards Léré, and return to Zangoula after the sowing to participate in the weeding of the fields there and to see if some fields have been left fallow that can be grazed. In Léré a night pen is made in the forest and water is abundant. In Zangoula the night pen is made in a glade close to the household. Water is obtained from temporary creeks.

The grazing pattern has changed. 20-25 years ago they used the areas close to Zipa 1 lkm south of Sanogo, but were forced away by agriculture. They then moved to Zangoula 9-12 years ago. The future in Zangoula is not good as there is not much grazing land left. They are considering moving to Ghana permanently if possible.

Sanogo case 2: Fulani with 18 cattle of which 16 are entrusted. Lives in Sanogo. All cattle kept together.

Post-harvest: Grazing at Bisa farmer fields in Sanogo.

Dry season: The cattle are kept around the household and in the fields in Sanogo. On the field they eat crop residue (leaves and small stems) and grasses. In the evening they are in the depression. A night pen is made on own fields in Sanogo. In the beginning water is found in the depression, but later on in the dry season it dries out and temporary wells in the depression are used as well. The permanent well is also used by the household.

First rain: Follow the rain. In '96 they went to Bagré 24km SE of Sanogo. After 20 days they returned to Sanogo when it started raining there.

Rainy season: They prefer to stay in Sanogo as they need the labour in the fields. It depends however, on the availability of fallow fields and non-cultivated patches of forest and the degree of flooding in the depressions. In '96 they went to Lergo and the 2 years before that they were able to stay in Sanogo. The night pen is made of branches on high ground. Had to pay a fine of 10.000CFA for cutting branches for the night pen in '96.

Transhumance to Zangoula is a relative new pattern that they started within the last 10 years.

b) Lfirgn Fulani

In Lergo, the situation is less critical than in Sanogo. Pockets of forest still exist where the herds can find grazing with a more acceptable risk of divagation into the Bisa fields. The grazing pattern has therefore not undergone the radical changes that characterise the Sanogo herds. The general pattern is that the herds stay within 5 km from Lergo for most of the year. After the harvest, almost all herds graze on the stubble fields in Lergo though a few find that the fields in the southern areas towards Zangoula offer better grazing opportunities. Close to Lergo, a small irrigation dam (Lake Lergo - see aerial photo page 136) offers relatively good watering until late in the dry season when the water becomes too stale and salt. Later in the dry season it is the same picture though there is some tendency to move towards Zangoula because of bushfires.

With the arrival of the first rain it is common to track the areas that have received the early rain, but most of the herds return to the Lergo area relatively early because their manpower is needed in the fields. The herds are then guarded by the children in the patches of forest available.

Figure 34 Watering of Fulani cattle at well in Sanogo

The picture is more blurred than in Sanogo though. 3 out of 11 Fulani find the Lergo area to be too difficult and move away for all or most of the rainy season. Others would have moved away if it were not for the need for manpower in the fields. In addition, the high degree of entrustment in the Lergo herds may hinder the Fulani's mobility, as he is dependent on permission from the owners of the animals. Most Fulani maintained that it is normally not difficult to obtain permission from the owners to move the herds to the Zangoula area, as it is within a distance where the owner is able to check on his animals now and then. However, all Lergo Fulani who have entrusted animals also maintain that they would move far away permanently if they were not dependent on the owners. This indicates that the situation in Lergo is becoming similar to Sanogo, with limited grazing land available forcing the Fulani to find alternative areas.

Lergo Case 1: Fulani with 50 cattle of which 6 are entrusted. All cattle kept together.

Post-harvest: Cattle are grazing on Lergo fields, mostly their own. A night pen is made on own fields. Water is obtained at a well close by.

Dry season: When grazing is finished in Lergo the herd is taken to some forest areas towards Zangoula. The cattle here feed on grasses in the forest. A night pen is made in Bisa fields and water from the lake. Towards the end of the dry season the cattle return to Lergo as labour is required in the fields.

First rain: Cattle are kept in the forests as the fields are sowed. They will track the first rain. In 95 towards Lenga 15km SW of Lergo and in 96 they went to Sisili close to Bagré some 20km SE of Lergo. They will stay here around 1 month until the rain has started in Lergo and they have to go back to work in the fields. A night pen is made in small forests well away from the germinating crops and water is abundant at this time.

Rainy season: In the early rainy season they stay at Lergo, but as the ears of the crop gets larger, the cattle becomes difficult to control and they move to Lenga some 20km SW from Lergo. They would prefer to stay in Lergo to work in the fields, but too little forest and too many fields forces them away. 4 persons follow the cattle and 7 stay behind labouring the fields. While at Lergo they construct a night pen of branches for which they have to buy a 3-month permission to cut (3000CFA).

Before the creation of Lake Bagré at Zangoula they could let the animals stay in the forests there during the whole year which was easier. He's afraid it will be difficult to find adequate grazing in the future. He uses only one cattle corridor in Lergo leading towards S and SE, but there are problems with farmers cutting it.

Lergo Case 2: Fulani with 55 cattle of which 45 are entrusted. 13 dairy cows are kept at the household in Lergo in the rainy season and after harvest.

Post-harvest: The cattle graze on fields at Zipa close to Lake Bagré, 9km South of Lergo. They would prefer to stay here during the whole of the dry season, but because the fields and the bush is burned for hunting all the way to the shores of the lake in January, they have to return to Lergo. A night pen is made on the Bisa farmers' fields. The Bisa sometimes pay for this with some millet, but later in the dry season the farmers have left and therefore do not know that the animals are there.

Dry season: The cattle graze in the patches of forest around Lergo and on fields where they eat the steins of the crops. In the afternoon they take them to the depression north of Lergo. A night pen is made on their own field and water is obtained from a well at the household.

First rain: The first rain is tracked. In '94 towards Béguédo 20km NW, in '95 towards Bagré 20km SE and in '96 they stayed in Lergo. A night pen is made on the fields until they are sown. Water is abundant.

Rainy season: The cattle are kept in the small forests close to Lergo. He cannot take the animals further away as his children are too small to herd the cattle themselves, and he has to work in the field. A night pen is made in the same forests and water is abundant in small creeks. No specific cattle corridor is used as they zigzag their way through fallow fields or forest.

The grazing pattern has not change significantly during recent years.

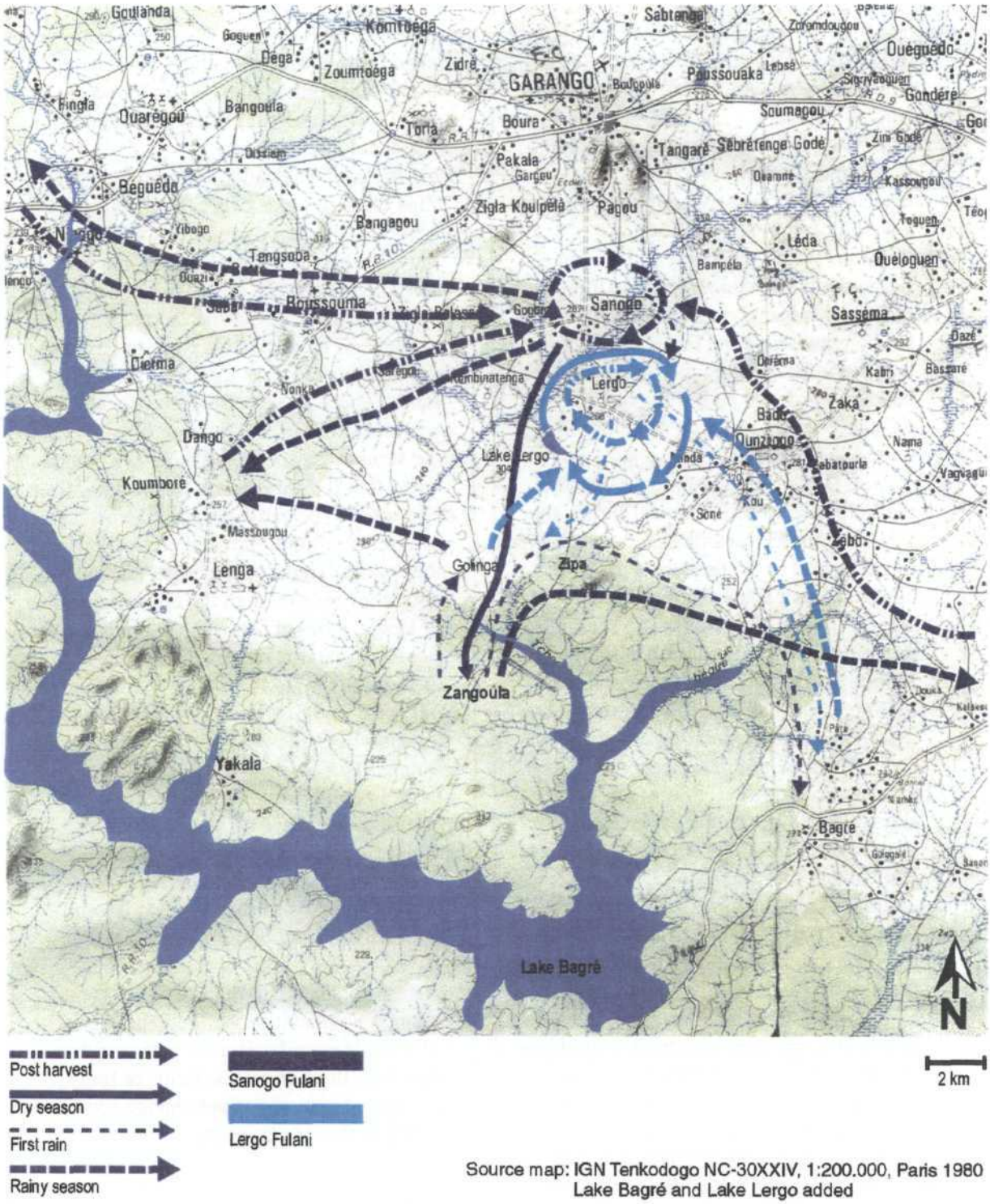


Figure 35 General grazing pattern of Sanogo and Lergo Fulani

To conclude, the differing grazing pattern in the two villages indicates a relationship between the pressure on the land and the mobility of the herder. In Sanogo, where the pressure on the land is highest, the Fulani are forced to go further away to find refuge for the planted fields in the rainy season, and have gradually established permanent satellite camps in the Zangoula

area where the young members of the family live and the majority of the herds are kept. In Lergo the pressure on the land is still less than in Sanogo, and the grazing pattern of the Fulani is more concentrated in the immediate vicinity of the village where the Fulani live permanently. Thus, the mobility of the Fulani is increasing with the pressure on land as the herder is forced to move further away to avoid crop damage during the rainy season. In the 1976 Delgado study from the Tenkodogo area, which is among the most densely-cultivated areas in the region, much longer transhumance distances of 60 km were found which may further confirm this relationship (Delgado, 1979b:30). Case studies from Northern Benin and Northern Côte d'Ivoire found similar correlations (de Haan *et al,* 1990:55; Basse«, 1994b).
Figure 35 summarises the grazing pattern of the two Fulani villages. It is based on the general patterns described by the interviewed Fulani, and not just on the four cases presented.

Thus it has now been shown how agricultural expansion in the area has led to changes for the Fulani both in relation to settlement and grazing pattern. However, these changes in the land use and lifestyle of the Fulani do not just happen automatically. They are the result of numerous small and large conflicts that eventually force one of the parties, in this case the Fulani, to adapt to the changed conditions. It is these conflicts that create hostility between the groups, which also affects the entrustment system. The following section will show the variety of resources that Fulani animal husbandry is dependent up, leading to an analysis of the causes of conflicts in the area.

c) Fodder resources

As the availability of animal fodder changes drastically with the seasons, the herder has to exercise a high degree of flexibility when finding fodder. This implies that the herder is dependent on a wide variety of resources throughout the year. This high diversity of fodder resources, however, also implies many potential conflicts as the farming systems are expanded.

There is a high degree of consensus among the Fulani that grazing in the forests is preferred to grazing on the fields. The usual reason given was that there is a higher diversity of grasses in the forests, and that the stubble grazing does not last more than 3 months. The leaves of the crop residues are considered good grazing, but the stems are only used when the animals are very hungry. As the forests are so much preferred it has become a big problem for the Fulani that large forest areas are burned every year apparently in connection with hunting. Also, agricultural expansion has led to a considerable reduction in the forests available, reducing fodder resources for the animals.

Table 15, below, lists the most commonly used fodder resources per season. It is compiled using several rankings and listings made by Fulani respondents. As can be seen, crop residues is an important source during the post-harvest and dry season, gradually being taken over by

trees later in the dry season. As can also be seen from the cases in Table 17, Appendix 1, White Sorghum is a particularly important source of crop residue. Millet leaves also rank quite high while Red Sorghum ranks rather low.

Seeno *(Andropogon gayanus)* is a popular perennial grass, but can be hard to find. Grasses in the depressions become important during the rainy season when the cattle have to be kept well away from the fields.

Season	Preferred feeding	Availability
Post-Harvest	Barere in depressions	
(Oct.-Nov.)	Rhemsa	
	White Sorghum Stems	
	White Sorghum Medium Grain Stems	
	Kjelbi Danegi	
Cold Dry Season	Kjelbi Danegi	
(Dec.-Feb.)	Red Sorghum Stems	
	White Sorghum Medium Grain Stems	
	Bareré in depressions	
	Rice leaves	
Hot Dry Season	Pilo-Pilo Leaves (bush)	Zemtaba
(Mar.-Apr.)	Kjéki (tree)	Kjelbi Danegi
	Allu'ude (tree)	Niello
	Khorlé (tree)	Parguri
	Grasses and stems as in cold dry season	Bogodollo
First Rains	Parguri	
(May)	Seeno	
	Bogodollo	
	Barere in depressions	
	Kagarire in depressions	
Rainy season	Seeno	Zemtaba
(Jun.-Oct.)	Parguri	Bogodollo
	Niello	Niello
	Barere in depressions	Parguri
	Kagarire in depressions	Seeno

Table 15 Five most preferred and most available fodder resources for cattle in various seasons (not ranked within season, see also appendix 1 for additional rankings and appendix 2 for scientific names)

In the late dry season a number of trees and bushes are also used as a grazing resource. Several rankings reveal that Khahi *(Khaya senegalensis)*, Aluude *(Acacia sieberiana)*, Alluki, Banuhi *(Pterocarpus erinaceas)* and Khorle *(Mitragyna inermis)* are preferred, but also Tanni

(Balanites aegyptiaca), Khaiki, *Tbi (Ficus gnaphalocarpa),* Pilo-pilo *(Combretum paniculatum),* Gilohi *(Stereospernum kunthianum),* Kjéki *(Faidherbia albida)* and Boodi *(Terminalia avicennioides)* were mentioned. Palouni *(Acacia seyal)* is used for making night pens.
The most commonly available trees for browsing are Kahi, Banuhi, Tanni, Aluude and Gilohi.

The rankings and listings illustrate the high diversity in the grazing used by the Fulani which includes a number of grasses in the forest areas and on the fallow fields, trees and crop residue. The maintenance of the herds therefore requires access to a variety of resources including harvested fields, fallow fields, forests, and depressions.
In Appendix 1 and 2, more detailed rankings of various fodder resources and listings of the scientific names for the grasses and trees that have been identified can be found.

Fodder for the animals is seldom cultivated. Extension programs have tried to promote fodder cultivation but many regard it as being too labour consuming compared to the alternative grazing resources available. Besides, cultivating fodder not only consumes labour, but also occupies land which, as mentioned, is increasingly a critical factor which, in the Delgado study, was seen as part of the explanation why farmers are reluctant to take on cattle rearing (Delgado, 1979a: 10). The provincial animal husbandry service notes, *"La plupart des champs fourragères sont implantés pour faire plaisir à l'encadrement'^*(SPRA, 1994:51).

It is common for the Fulani to gather leaves from groundnut and stems from white sorghum that are fed especially to the calves in the dry season around March. In addition, Bogodollo *(Pennisetum pedicellatum)* and Niéllo grass *(Rottbaillia cochinchinensis)* is collected occasionally. The white sorghum stems are preferred small and one Fulani maintained that this was why he collected them in the Bisa fields, as the manure on the Fulani fields makes the stems too big. Most Fulani complained that they are competing with the Bisa when collecting, as the Bisa are increasingly collecting crop residue for their draught animals. It is not new that they collect, but this practice is now so intensive that the Fulani often find nothing left for their grazing animals, which also means that the Bisa farmer will not get the benefit of the manure droppings on his field. The residue is often stored in trees near the household.
There are a few saltlicks in the area, but many herders now buy salt for the cattle, typically a sack of 50 kg for 3500-4000 CFA. Several of the older saltlicks are no longer used because they are sanded up.

Fulani animal husbandry is, therefore, dependent on a wide range of fodder resources throughout the year. Even though this indicates a high degree of flexibility it also makes them more vulnerable to the changes in the agricultural system as these are likely to affect several resources on which they depend. Had, for instance, the Fulani primarily been dependent on

one specific resource it would have been clearer that this specific resource should be protected in order to maintain the animal husbandry. However, as they are dependent on a variety of resources that may each have their own tenure and other arrangements associated with them, the consequences for the pastoralist animal husbandry become more opaque and the sources of conflicts also more numerous.

8. *Conflicts*

The forced migration of the pastoralists and the changing grazing patterns are the result of a process that results in numerous smaller and larger conflicts. Conflicts between Fulani herders and Bisa farmers in the study area are relatively common, and partly explain the sometimes hostile relationship between the two groups. In general, the Bisa would tell an outsider that the relationship between Fulani and Bisa is good or that they have no relationship. However, quite often wordings like *"the Fulani are hard and bad people", "the Fulani are thieves that steal your animals", "the Fulani are bad and destroy the crops"* or *"the Fulani are provocateurs"* are used, indicating that there are tensions between them. There are several sources for this hostility and the conflicts. The most important source of conflict is the divagation of animals into the Bisa fields during the rainy season leading to serious crop damage. However, also bushfires, the cutting of cattle-corridors, the gathering of crop residue, animal deaths and theft, access to water and land, and simple envy can lead to conflicts. In the following, each of these incidents will be dealt with as they all contribute to an understanding of the mechanisms which marginalise the Fulani.

a) Divagation and crop damage

The divagation of animals into Bisa fields is common. Seven out of eleven Fulani in Lergo reported that their herds had damaged crops within the last few years, while the corresponding number in Sanogo was 6 out of 8 though this often took place in Zangoula as the majority of the herds have been moved away from Sanogo. All of the Sanogo Fulani who keep their herds in Sanogo or the Lergo area are among those who have had problems. More than half of these incidents led to payment of compensation to the Bisa farmers, in the order of 7.000 to 50.000 CFA depending on the extent of damage. It is the general opinion both among the Fulani and the Bisa that divagation is a major problem. Disputes are settled either directly between the two parties or by the intervention of the Bisa and Fulani chief or in some cases the extension officer. There are no recent cases of disputes going further in the legislative system.

The pattern of more frequent crop-damages in Lergo than in Sanogo is confirmed by the Bisa as 18 of 47 (38%) farmers in Lergo reported having had crops destroyed in 1996 by Fulani

[69] "Most of the fodder fields are planted to please the extension officer"

herds while the corresponding figure for Sanogo was only 7 out of 50 (14%). This difference must be seen as a result of the resettlement of the Sanogo Fulani that was originally initiated by these conflicts.

The divagation of animals and the resulting damage of crops is detrimental to the relationship between Bisa and Fulani. The many small conflicts lead to mistrust and animosity, something that is often expressed openly in strong language and which recently led to an armed conflict in the Bagré area some 35 km to the Southeast in 1993[70] (Faho, 1995). The frequency of conflicts over divagation has, according to some respondents, increased in recent years, but there are not sufficient data available to allow a reliable conclusion. It is, however, not a new phenomenon in the region as the Delgado study also mentions conflicts of this sort to be common in the densely-cultivated Tenkodogo area (Delgado, 1979a: 154) and a study in the same region as the present study found that conflicts had increased due to agricultural expansion and increasing numbers of animals, partly due to northern-based transhumant Fulani migrating though the area towards southern pastures (Faure, 1990:348). The Faure study also mentions that this could be aggravated with the, at that time planned, inundation of 15.000 hectares of grazing areas bordering the Nakambé river in connection with the establishment of the Lake Bagré. Studies from other regions have also found conflicts between herders and farmers to be an old phenomenon (Breusers and Nederlof, 1998; de Haan *et al,* 1990:57; de Haan, 1998). With the agricultural expansion going on and the resulting migration of a large part of the pastoralists in the area, however, it is quite plausible that the conflicts have increased as a response to agricultural expansion.

[70] This conflict did not directly involve the Bisa and Fulani of the study area.

b) Bushfire

Figure 36 Bushfire close to Lergo Fulani, January 1997

Bushfire is a major point of concern for the Fulani. As has been shown, bushfire is one of the reasons for the changes in the grazing pattern of the Fulani. Large areas of fields and bush are burnt annually. During the fieldwork, it was observed that most of the area between Lergo and Zangoula had been burned to varying degrees. The Fulani claim that the Bisa farmers do it and that it is a relatively new phenomenon that started 6-10 years ago. Before that time, bushfires happened occasionally as accidental fires caused by smoking. Most Fulani claim that hunting is the main source of bushfires, which are sometimes caused by the children, but several also suspect that they are a deliberate act of retaliation against the Fulani for the divagation of animals. Both Fulani and Bisa claim that bushfires are often started at night.

In Lergo, in 1995, the Fulani tried to build firebreaks around the forests, which improved the situation, but in 1996 the fires started earlier and they were not in time to prevent it. Some Bisa farmers also burn fields as part of field preparation. Most Bisa farmers do not approve of the burning, though it is acknowledged that some burn their fields deliberately. A few Bisa also claimed that the Fulani do it in order to encourage new sprouts. Though this practice has been observed elsewhere (de Haan, 1998:218; Jean, 1975:37; Basse«, 1994b: 156), the Fulani in Lergo and Sanogo generally see bushfires as a menace and actively seek to prevent them, hence it cannot be expected that they would start bushfires themselves, at least not on a larger scale and early in the dry season. Local extension staff also confirm that the Fulani no longer practice bushfires, partly because precipitation no longer is sufficient to encourage new sprouts.[71]

c) The nutting of cattle-corridors

The cutting of cattle-corridors has also been mentioned as a serious problem for the Fulani, rendering trouble-free passage during the rainy season difficult. The Fulani need relatively wide corridors of at least 100 meters if they are to prevent damage to the surrounding fields (de Haan, 1998:221), but in the study area several corridors were observed to be down to 10-

[71] Personal communication with Joseph Sorbegou, Encadreur/Veterinary, Bagre.

15 meters wide. Narrow corridors not only make it difficult to avoid crop damage, but also do not provide any grazing in themselves, which can be a critical factor when the herder has to decide whether to stay or to leave during the rainy season. As mentioned, cattle corridors in Sanogo have been reduced from 4 to 2 during the last 20 years. The Bisa farmer enlarging his field occasionally cuts the remaining corridors. In such cases, the Fulani can complain to the Bisa Chief who normally orders the farmer to keep the corridor free. However, although the Fulani is able to prove his rights in these cases, crop damages may already have occurred, and the conflict in itself does not improve the relationship between the fanner and the herder.

d) The gathering nf crop residue

The gathering of crop residue was mentioned in the previous section (page 181) as an activity that in effect reduces the grazing resources available to the Fulani close to his household. In Lergo almost all Bisa farmers who own animals also collect white sorghum stems and groundnut leaves. The residue is traded in a few cases, hence it may develop into an important commodity if the grazing resources are reduced further. Widespread use of crop residue by the Bisa farmers was also confirmed by local extension staff.[72] Competition over the crop residue, is therefore another issue that is not conducive to good relations between the two groups, a concern that has been identified in a similar area in Northern Benin (de Haan, 1998:223).

e) Competition over land

Though not directly leading to conflicts, competition over land may be another factor undermining the relationship between the Bisa and the Fulani. As mentioned in previous sections, uncultivated bushland is still available to the south of Lergo, while free land close to the villages is difficult to find. As the Bisa are in control of allocation of land to the Fulani, this could become a point of concern in the future, though, at the time of the fieldwork, it was not a major problem.

However, in the depressions the establishment of small, irrigated gardens and fields has implications for the Fulani. The relatively new tendency to develop gardens restricts their access to the depressions not only in the rainy season but all year round. This is problematic for the Fulani with respect to water and grazing. As mentioned, the depressions become one of the easiest watering points during the dry season as shallow wells can be dug in the seasonal river beds. The presence of the gardens not only physically hinders access, but also poses an irresistible temptation for the cattle. The gardens are well protected with thorny branches, but the cattle are renowned for being quite sly and break into the gardens by dragging away the branches by deliberately letting their tails get entangled in the twigs. The compensation that

[72] Personal communication with Joseph Sorbegou, Encadreur/Veterinary, Bagre; Pierre O. Sayoré, Director SPRA, Tenkodogo.

must be paid can be high, as the garden-crops are valuable. As can be observed in Table 15, page 180, some grass species only found in the depressions are among the preferred fodder in both the rainy and the dry seasons. Barring access to this resource further limits the grazing resources available to the herder.

As private ownership of these gardens is exclusively in the hands of the Bisa, this may further provoke the dissatisfaction of the Fulani, as they are being menaced by a lucrative activity to which they have no access. This may therefore aggravate the distance between the two groups and reinforce conflicts ignited by other incidents.

f) Access to water

Access to water was mentioned as a problem by a few Fulani and Bisa. There had been cases where access to water was denied to one of the groups. However, these seemed to be relatively isolated cases, and several cases of unproblematic sharing were also observed. This could, therefore, be a result of an already bad relationship, but as water is not normally the most limiting resource, it would not in itself be expected to be a major point of competition.

g) Animal death and theft

Animal death and theft are serious problems both for Fulani and Bisa that can initiate conflicts when the Bisa has entrusted animals to the Fulani. The animals are very valuable, and the Fulani therefore manage a very important asset requiring a high degree of trust. When an animal dies, the Fulani have to present the tail or the horns of the animal to the owner in order to prove that it really is dead. However, as the animal is often outside the direct control of the owner he basically has to trust the Fulani's word, and even if he does, it does not free the Fulani from blame for the death of the animal. The Fulani often complained about the mistrust of the owners, and for several these problems are the main reason why they have either stopped taking entrusted animals or have reduced this practice as much as they can afford. This is especially the case in Sanogo, while in Lergo most Fulani do not have problems with the owners. This supports the observation mentioned previously that entrustment is much more prevalent in Lergo. It may, furthermore, indicate that it is conducive for the entrustment system that the farmer and pastoralist live close by each other. With the forced exclusion of the pastoralists because of agricultural expansion, the conditions for entrustment are, consequently, jeopardised.

Figure 37 Sanogo Bisa farmer with the horns and tails from cattle that died while entrusted to Fulani herders

The theft of an animal may, like death, also trigger a conflict. Either the Fulani is blamed directly for having stolen and sold an animal or he is blamed for not having avoided the theft. However, though often talked about, actual theft of animals is not common.

h) Envy

Envy was mentioned quite often by Fulani as a reason for their bad relationship with the Bisa fanners. The value of cattle has increased considerably since the devaluation, and Fulani with large herds are rich according to local standards. In addition, the relatively high yield from the Fulani fields, which is ascribed to their access to plenty of manure was mentioned to be a thorn in the side of some Bisa fanners. Though hard to pinpoint, this may be a factor that may reinforce a conflict.

There are, therefore, several potential sources of conflict that can create animosity between the Bisa farmer and the Fulani pastoralist. While there are only few direct data to suggest an increase in the occurrence of conflicts, incidents like divagation, the cutting of cattle corridors, bushfires and the gathering of crop residue, which are among the most serious sources of conflicts, have increased. It is therefore plausible that these have led to more conflicts and have aggravated the relationship between the two groups. An assessment as to whether or not conflicts have become more common will invariably be based on subjective evaluations by the involved parties, as conflicts of this sort are difficult to quantify as they are not registered. Therefore, an examination of the various sources of conflicts is likely to give a good and possibly more reliable indication hereof.

It has been maintained, with a case from the Mossi Plateau in Burkina Faso, that the apparent animosity between farmers and herders is in reality a "front-stage discourse" performed with the objective of concealing the fact that the farmer has entrusted animals to the herder and has hidden his personal wealth from view (Breusers and Nederlof, 1998). Although such an explanation is interesting and compelling, entrusting may not be that much of a secret, something which is supported by observations from the present study area. The number of animals is assumed to be a secret, but not the fact that the farmer entrusts animals to the pastoralist. Besides, an explanation such as the one presented by Breusers and Nederlof does not nullify the various sources of conflicts described above, hence the conflicts should still not be seen as being merely illusory (Oksen, 2000).

As mentioned, the conflicts and the often hostile relationship between farmers and herders are detrimental to building up trust. As trust is a precondition for the entrustment system, this

animosity is likely to have far-reaching consequences, as will be discussed in the following section.

9. *Entrustment*

It has been shown how Sanogo and Lergo display different degrees of land saturation leading to agricultural domination with only few cattle herds remaining. This difference is also apparent when looking at entrustment.

Entrustment is an important aspect of livestock management in the region. As has been discussed in section IV.C.3, page 63, entrustment is intrinsic to the mixed farming model and holds important advantages both for farmer and pastoralist. In the study area, it has been shown to be crucial for the feasibility of the Bisa farmers' cattle rearing (Delgado, 1979a) and thereby their possibilities for further agricultural intensification, which implies animal traction and manure supply.

The figures below[73] show that entrustment is much more common in Lergo than in Sanogo. In Lergo, 59% of the cattle herded by the Fulani are owned by the Bisa farmers. Among the Sanogo Fulani, only 15% of the cattle are entrusted.[74] All the Fulani in Lergo have entrusted animals in their herds while in Sanogo this is not always the case.

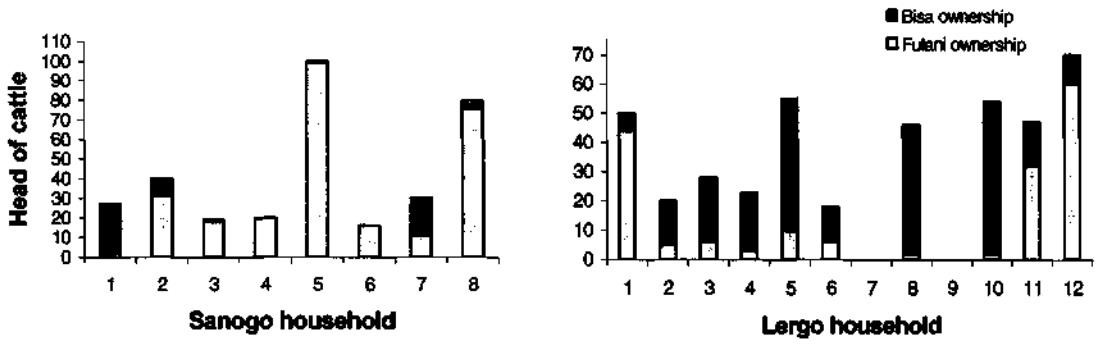


Figure 38 Ownership structure in Fulani cattle herds. Ordinate scales differ.

[73] Please note that all figures concerning ownership of animals are subject to uncertainty for reasons mentioned in the methodology section.

[74] For the sake of comparison, it is worth mentioning that the Delgado study in the Tenkodogo area found that 60% of the Fulani cattle were entrusted (Delgado, 1979b:67)

For the Bisa herds, the picture is similar, as can be observed in Figure 39. In Sanogo, 29% of cattle owned by the interviewed Bisa are entrusted to the Fulani, while in Lergo this figure is 40%.
Altogether, only 8% of the interviewed Bisa farmers in Sanogo entrust cattle to the Fulani, while in Lergo 18% entrust. In Sanogo, 26% of the interviewed farmers own cattle and 30% of those have entrusted some or all of their cattle to the Fulani. For Lergo, 40% own cattle and 47% of those entrust.

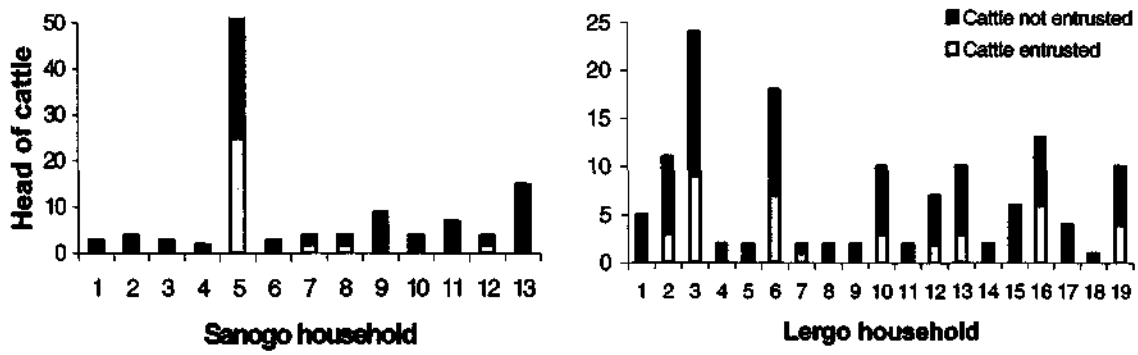


Figure 39 Ownership structure in Bisa cattle herds. Ordinate scales differ.

The Bisa do not always entrust all of their cattle. On average, Bisa farmers who do entrust have given 3,6 cattle to the Fulani.[75] Often, the Bisa hold back a few cattle at the household. The most prominent reason the Bisa farmers gave for entrusting animals, mentioned by 69%, is that the Fulani are good herders and are better at taking care of the animals than the Bisa, both with regard to finding the best grazing and treating diseases. However, 13% mentioned that lack of children who can work as herders is the most important factor for considering entrusting. Several Bisa explained that they would prefer to keep the cattle themselves as they can use the milk and the manure in the fields, but that they do not have enough children that can look after the animals.

Altogether, one third of the Bisa farmers interviewed in both villages own cattle, and 60% of those do not entrust. The most common reason for not entrusting is that they only have one or two cattle and that they have children who can overcome the task. However, 32% of them mentioned that they do not trust the Fulani or simply do not like them. Of the Bisa farmers who do not entrust, 26% had entrusted before, indicating a decline in entrustment generally. When asked whether they would entrust in the future, a large difference emerged between the

[75] One exceptional farmer with 25 cattle was left out of the calculation

villages as all except one in Lergo claimed they would do it in the future if they should be so lucky to have many animals, while none, except maybe one, in Sanogo would do it.
The Bisa farmers thought that it was important to have known the Fulani, and preferably also his parents, for many years, if they were to entrust their animals to him. The entrusting is a long-term arrangement, as 85% of the Bisa farmers entrust every year and they use the same Fulani herder every year.

The data suggest a much higher prevalence of entrustment in Lergo than in Sanogo. Animal husbandry in general is also more prevalent in Lergo, and the Fulani keep their herds closer to the village. The conditions for maintaining the entrustment are therefore better in Lergo. It is important for the owner to be able to keep an eye on his animals, and that is easier in Lergo. In addition, the forced resettlement of the Sanogo Fulani must be assumed to have taken place because of conflicts, as the herder under normal circumstances would prefer to stay in the original villages. The process of field expansion is likely to be accompanied by conflicts, as mentioned in the previous section, and the expansion and ensuing conflicts are the main reasons for the Fulani resettlement. The conflicts aggravate the relationship between the farmers and the herders, and the trust necessary for the entrustment system to function is thereby undermined. Thus, the difference in entrustment found between the two villages points to the consequences of expansion on the entrustment system. As has been discussed in section IV.C.3, page 63, the entrustment system is crucial for the feasibility for the Bisa farmer of keeping cattle. The higher prevalence of cattle in Lergo compared to Sanogo may thus confirm the importance of entrustment for the Bisa farmer's ownership of cattle, be it for traction or for investment. Thus, the findings from the Delgado study seem to be confirmed by the data presented.

However, with the Fulani, entrustment is no longer popular. For the Fulani, entrustment is normally only done when he does not own many animals himself. It then becomes a source of income through the sale of animals and through the milk and manure. Only 2 of 22 Fulani think that entrustment is a good thing because of the milk and the manure. The rest (91%) are not in favour of entrusting. One Fulani summarises the reason for this as:

> *"I stopped because I was accused of stealing the animals and because of conflicts over crop damage. Also, it does not pay to do it and the Bisa do not pay for installing the animals on their fields either. Before, there was more agreement between the Bisa and the Fulani and it was easier because there were not so many fields. There was pasture, no theft, and no fines. Now there are more people who compete for the land. I might do it again, though, if it is a good Bisa who asks me".*

Conflicts with the owners were the most frequently mentioned problem, but also dissatisfaction with remuneration and the difficulties of herding because of the many fields. Most Fulani will, however, continue to take entrusted animals, though several expressed doubt that the

entrustment system would survive in the future, mostly because of conflicts and because the Bisa would prefer to keep the animals themselves.
Around one third of the Fulani said they would not take entrusted animals if they had more animals, 10 being the number mentioned by most to be sufficient. However, very few Fulani have actually stopped taking entrusted animals, even though they own more than 30 cattle themselves.

The Fulani normally herd the cattle of several Bisa farmers. On average, there are 4,7 owners in a Fulani herd with the maximum being 19 owners in a herd of 45 heads. They own on average 3,6 head of cattle (standard deviation 2,7). Most of the owners are from Lergo and Sanogo and some from other villages nearby. Only one case was encountered of an owner coming from Ouagadougou or another distant large city, and entrustment must therefore be characterized as a very local phenomenon. As discussed in section IV.C.3, page 63, this means that entrustment in the study area is seen as part of the local land use system in contrast to the absentee ownership that is seen as external and therefore not associated with the same advantages. Entrustment is mostly based on year-long acquaintances and several have taken over the entrustment from their parents. New owners were encountered, but the Fulani and the Bisa normally know one another well beforehand.

As mentioned, the animals entrusted are a mix of young and old, males and females. The cattle entrusted are most often females that are staying with the Fulani during the whole year. Of the 63 head of cattle entrusted to the Fulani by the interviewed Bisa in the two villages, 82% are female and 18% are male.[76] Most of the males are draught animals and 38% of the Bisa farmers entrusting keep these animals at the household for labour in the fields in the rainy season. Cows are most popular among the Fulani because of the milk. Often, the Fulani only keep the bulls destined for draught till they are around 4 years whereafter the owner collects them and keeps them permanently. A few Fulani mentioned that the Bisa took some of the bulls back during the dry season so that they could be fed with crop residue the owner had collected.

In return for his services, the Fulani typically has the right to the milk and manure from the cattle. It is also common that he is given a part of the sum when an animal is sold, typically between 1000 and 5000 CFA. In some cases, the Bisa proprietor helps the Fulani in ploughing the fields with draught animals, and sometimes millet is donated. The practice of giving the Fulani a calf occasionally is not practiced. Most Fulani stated that it used to be common for the Bisa to give millet and clothes as part of the payment, but as the Fulani now have fields themselves with good harvests, this has become more rare. For most Fulani, the payment was

[76] For 6 cattle the sex is unknown and they have been left out. The figure is probably underestimated

not satisfactory especially because they maintained that the milk yield from the cows had declined.[77]

All Fulani explained that the Bisa farmers have more cattle now than before because they are using them for traction. All except one also explained that the Bisa entrust less than before because they prefer to keep the cattle themselves but also because the Fulani are reluctant to take them due to the conflicts and the decline in milk production.
It is the general opinion of the Fulani that the Bisa will have more animals in the future and that this will lead to more problems for the Fulani because of competition over grazing resources. The citations in the textbox are representative of the opinion of the interviewed Fulani.

Opinions of three Fulani pastoralists:

"The Bisa own more animals now than before, but give less in entrustment. 2-3 years ago they also gave draught animals but the Fulani will not take them anymore, as the Bisa do not help the Fulani to plough. Before, taking care of the animals was a Fulani métier, but now it's less. There isn't enough pasture and the cows give less milk than before. My father had many entrusted. It is also because children today will not work for nothing. Even if the Bisa have more animals today, they keep them for cultivation and for manure and therefore they keep them themselves. Before there was more milk, and the Fulani did not know about cultivation."

"The Bisa have more animals now, as they have seen that it is good to have animals. They have them both for traction and because the prices have gone up. In the future, they will get more, but they cannot take them far away as the Fulani like to do at the first rains, because they have to stay in one place. They don't give so much in entrusting anymore as they mostly have draught animals which are males."

"Generally there is less entrusting now because of accusations of theft and crop damage. The Bisa mostly have males for traction and therefore their children take care of them. The Bisa have more animals now as they use them for traction and for the plough. They have both cows and bulls. They keep the cows for sale and don't milk them. They keep them for themselves. It was 10 years ago that they started having cows. In the future, the Bisa will have more animals, and then they will force the Fulani away from the fields as they will need them for their own animals, and the Fulani must move away. The Bisa do not know how to keep animals well. When the animals are sick they must ask the Fulani for advice. There are 3-4 diseases that the Bisa cannot distinguish from one another. The Bisa get money for the animals from their gardens. The Fulani need the forest and have a right to it."

[77] Also confirmed by the local veterinary service (personal communication with Joseph Sorbegou, En-

Most Bisa maintained that they had experienced a decline in their herds, mostly due to disease, but as discussed previously (page 155) there are indications that in general the Bisa herds have augmented. The following statement illustrates the view of the Bisa farmers:

> ***Opinion of a Bisa farmer:***
> *"The Bisa have more animals now than before; cattle, goats, sheep and donkeys, and also horses though horses, are not common here. This is because there are more Fulani who have come from the north, and as they damage the crops we need more animals to sell to buy cereals. It is also because there is more money in animals now. The Bisa will have more in the future, but it is difficult for the Bisa to afford to buy animals. Before you could sell the surplus harvest to buy animals, but today you need someone to help you in the field. "*

Thus, there are strong indications that entrustment has declined and is maybe on the verge of disappearing. This is a two-way process in which both the Bisa farmer and the Fulani herder are finding it increasingly disadvantageous to enter such arrangements. The Bisa are increasingly acquiring cattle for draught and keep them at the household or invest in cows for the profit and keep them to take advantage of the manure. It seems that the main reason for entrusting is if the Bisa have more than just a couple of animals and therefore have difficulties finding surplus labour to guard them. When the Bisa have only a few cattle, they will typically keep them themselves, as this is easier for the children to manage. In addition, the Fulanis' reputation for being expert herders is an important incentive. Likewise, the Fulani are reluctant to take entrusted animals as milk production, which is one of the most important incentives, is declining. This is also directly related to expansion, which makes herding more difficult, thus taking away labour that the Fulani also need for the fields. The remuneration also seems to be insufficient to outweigh the extra risk of crop damage which an enlarged herd represents. In addition, the risk of being accused of stealing animals is discouraging.
The decline on entrustment was also confirmed by the local extension staff, who stated that even though the Bisa now own more animals, they tend to keep them themselves.[78]

As mentioned, theft of animals does not seem to be widespread, though it is often talked about. There are no general rules for how often the owners inspect the entrusted animals, as this ranges from several times a month to once a year. It is assumed to be dependent on the relationship and the trust between the farmer and the herder. The same applies to the practice of asking the owner before the animals are taken on transhumance. Most Fulani explain that they normally ask before leaving for the first rains, but not all find this necessary and normally they have no problem getting the consent of the owner. This is related to the short range of

cadreur/Veterinary, Bagre.
[78] **Personal communication** with Pierre O. Sayoré, Director SPRA, Tenkodogo; Joseph Sorbegou, Encadreur/Veterinary, Bagre.

transhumance, as it is relatively easy for the owner to go and inspect a sick animal. However, of the Fulani who take entrusted animals, 67% would use much more distant pastures during the dry season and in some cases also during the first rain if only they herded their own animals. Entrustment therefore has a direct influence on grazing patterns, and may contribute to making entrustment unpopular among the Fulani.

The increased animal husbandry among the Bisa may also have environmental consequences, as the following citation from a World Bank publication suggests:

> *"Where sedentary farmers and transhumant herders have coexisted in symbiotic land use systems, the incorporation of livestock activities into settlers' farming systems also tends to cause difficulties for the pastoralists, who are then compelled to keep their herds increasingly on pasture land alone. As a result, soil fertility declines more rapidly on such rangeland" (Cleaver and Schreiber, 1994:53)*

No specific investigations into whether or not such environmental consequences can be identified have been carried out in the study area, but if access to crop residue is restricted, especially in the cold dry season where this fodder resource is most important, this is likely to increase the use of trees, which becomes increasingly important as the dry season progresses (see Table 15 page 180). This could add to deforestation, already significant due to agricultural expansion, which may have negative environmental consequences in terms of increased soil erosion, microclimate changes and decreased bio-diversity.[79]

Entrustment among the Fulani themselves in order to spread their herds and thereby minimise risk in relation to disease, theft and drought, is rarely practiced. Elsewhere, it has been found that a reciprocal relationship may help a destitute herder to reconstitute his herd. However, in the study area the reason given by almost all Fulani for not doing this was that they only have few animals, and if they should divide the herd it would be among their own children. Only the wealthiest Fulani had given a few cattle to another Fulani to help him.

Entrustment is an important part of livestock management in the region because it allows the Bisa farmer to invest in cattle without compromising crop production, and as it is an important source of subsistence for Fulani with small herds. However, trust is being undermined by conflicts over damaged crops, which are a direct consequence of agricultural expansion. The herds entrusted represent a very high value, and the Bisa therefore prefer to have known the

[79] No specific investigations have been made into the relationship between deforestation and agricultural expansion. However the assumption can to a certain degree be justified as it is not normal practice in the study area to leave trees standing in the cleared fields.

Fulani for many years before they dare entrust animals to him. This animosity between the Bisa and the Fulani nmakes it hard to establish the trust needed for entrustment, and the entrustment system is therefore in danger of disappearing.

As has been demonstrated, the Fulani have been forced to move away more or less permanently in Sanogo which is reflected in large differences in entrustment between the two villages. Because of the proximity and close relations between the two villages, it would be reasonable to assume that they are comparable. Of course, many issues influence the local land use systems, but there are no salient features in any of the villages that would invalidate such a comparison, at least with respect to agriculture and animal husbandry. Like this, the analysis in the previous sections of present-day relationships in the villages can, together with the historical data that has been obtained primarily through interviews, provide a picture of what processes of change are taking place. The two villages are under the influence of the same forces of change, and they may therefore reveal a developmental tendency. This tendency is that entrustment has been declining, as the Sanogo village has been moving towards a distancing of animal husbandry by pastoralists from the farming society, which has meant fewer interactions with the Fulani with respect to entrustment. In Lergo, the same process seems to be taking place according to the data presented and the various statements of the local population, hence a comparison between the villages confirms that there is a tendency for a decline in the entrustment system. With caution, it may furthermore be pointed out that this process is likely to continue if the present development trend continues in the future. There are no indications that the process that has taken place in Sanogo should not continue in Lergo, i.e. continued agricultural expansion and consequently worse conditions for the Fulani and the abovementioned implications for the development of the region. As such an extrapolation of results would be very uncertain at best, it will not be used for further conclusions. Suffice it to say that there are indications that point to a continued deterioration of the Fulanis' situation in the region and that this could be a point of departure for development policies to counteract this apparent risk.

The tendency for the entrustment system to disappear because of the undermining of trust was also found in a study in Northern Benin. The region here is, in terms of agro-ecology, relatively similar to Boulgou and herding practices are in many respects identical. It was found that agricultural expansion and the resulting conflicts over access to grazing land and crop damage, together with animal deaths especially in the dry years have led to a polarisation of the fanners and the Fulani. This process that has also been accompanied by violent conflicts (de Haan *et al,* 1990:58-59; de Haan, 1998:213,221). Moreover, on the Mossi Plateau in Central Burkina Faso, the same link was also found between agricultural expansion and the decline of entrustment (Reardon *et al,* 1988:1072).

To sum up, there are several indications that the entrustment system has declined and may be in danger of disappearing altogether:

1) Several of the Bisa and all of the Fulani stated that entrustment has decreased, even though there are strong indications that Bisa cattle herds have increased.
2) A large share of Bisa farmers have stopped giving animals in entrustment (26% of non-entrusting farmers).
3) There are large differences in the frequency of entrustment between the two villages. To the extent that the two villages can be seen as along a continuum, i.e. that the changes that have taken place in Sanogo are now today also happening in Lergo, then it must be expected that entrustment will also decline in Lergo as it has done in Sanogo due to the forced resettlement of the Sanogo Fulani.
4) This process of declining entrustment due to agricultural expansion and frequent conflicts has also been observed in similar regions.
5) Local extension staff confirm a decline in entrustment.

As was discussed in the theoretical section entrustment can be viewed from both a positive and a negative angle. It has here been posited that the type of entrustment dealt with in this study cannot readily be compared to the form of entrustment that builds on absentee ownership. However, even locally one finds different opinions of the entrustment system among the people engaged in it. It does not seem very popular either among Bisa farmers or Fulani pastoralists. However, the reasons given for this unpopularity are related to the changes that have taken place in the area, and most of these can be ascribed to agricultural expansion. Thus, from the preceding analysis, it must be concluded that the negative perception of entrustment is related to these changes and therefore that it constitutes a distinct change in attitude.

In this study, I do not propose that the present situation should merely be seen as a deterioration of a distant, harmonious past where farmers and pastoralists lived in a symbiotic relationship. There are elements of symbiosis in the entrustment system, but as this term is so positively laden I much prefer the more neutral term "complementary links", as entrustment is not necessarily a guarantee of a frictionless coexistence. The fact that entrustment is on the wane does not imply that there were no problems in the past. The villagers do not indicate that conflicts are a new phenomenon and it would be rather peculiar if crop damage and accusations of theft did not also take place in the past. However, with this in mind, it must also be acknowledged that the situation has changed dramatically in one very basic aspect; access to adequate grazing resources, be they in the rangelands, the depressions or in the stubble fields. It has been shown how these changes have resulted in the forced resettlement of the Fulani into surroundings that are also now becoming increasingly difficult for the Fulani to negotiate.

The findings presented in the preceding sections suggest a correlation between the possibilities for entrustment and the adoption of animal traction by the farmers. However, it was also

shown that the majority of animals entrusted to the Fulani were female cattle that are not used for traction purposes and that the adoption of animal traction among the fanners has actually increased. It may therefore be questioned how this fits into the hypothesis of the expansion paradox. There are several issues that are important here:

First, even though adoption of animal traction has increased, the data show that animal traction is still more widespread in Lergo than in Sanogo, even though pressure on land, and hence shorter fallow, is more pronounced in the latter. The correlation between entrustment and animal traction therefore seems to be confirmed when comparing the two villages, although they cannot be interpreted as being the only explanation because of possible multicolinearity.

Second, the small percentage of draught animals entrusted does not imply that entrustment is not important for the feasibility of animal traction. It is not surprising that the farmer choses to keep the draft animals at the farm if possible, as he then will have them close-by when he needs them during the cropping season. This will, however, be associated with opportunity costs in relation to labour, and may be interpreted as a consequence of the Fulani having been forced to move further away with the entrusted animals during the cropping season. As the data indicate that farmers more often gave draft animals in entrustment in the past, this supports that conditions for having animals for traction have deteriorated.

Third, as discussed previously (page 54), introduction of animal traction represents an important investment for the farmer. If the profitability of having cattle and thus using animal traction is to be realised on a long term basis, the farmer will also have to invest in cows, that not only can provide a direct profit, but that may reproduce and as such maintain the initial investment by providing new animals that can be used for animal traction. Thus, when the fanner's possibilities for keeping animal husbandry in general are aggravated, it also influences the profitability or the cost of using animal traction in farming.

10. Summary

The Fulani in the study area reveal a settlement pattern that reflects the differences in the two Bisa villages discussed in the previous section. The Fulani of Sanogo have been forced by agricultural expansion to move to areas south of Lergo close to Lake Bagré, while the Fulani in Lergo still reside close to the Bisa village. The grazing patterns of the Fulani also show a marked difference between Sanogo and Lergo, where the latter is characterised by a less mobile grazing pattern especially during the rainy season where it is still possible for the herders to find pockets of forests where the animals can be kept close to Lergo but well away from the Bisa fields. However, agricultural expansion makes it increasingly difficult for the herder to avoid stray animals damaging the crops of the Bisa farmers. Such incidents are fairly common, and often end up with the Fulani paying large fines in cash, but may also lead to conflicts between the two parties. However, crop damage is just one of several reasons for conflicts, and an often quite hostile relationship exists between Bisa farmers and Fulani pastoral-

ists. Bushfires are a serious point of concern that force the herder to move to distant pastures and for which the Bisa farmers are blamed, although the Fulani themselves may also be involved. The cutting of cattle corridors and competition over access to land and crop residue are also major sources of conflict, and the accusation of theft or mismanagement of entrusted cattle leads to mistrust. The Bisa have increasingly taken up animal husbandry both for traction and investment, which may be an advantage for the herder through the widespread entrustment system, but may also increase competition over pastures and crop residue. Entrustment is suffering due to the deteriorated relationship between the two groups. Building on trust established over many years, this system is vulnerable to conflicts and animosities, and it is now increasingly unpopular among both groups. Entrustment is much more prevalent in Lergo than in Sanogo, which is due to animal husbandry in general being more widespread in Lergo. There are strong indications that entrustment in the study area is, therefore, diminishing. With reduced opportunities for entrustment, the Bisa farmers have to allocate labour to herding, for which the peak requirement coincides with the highest labour need for crop cultivation during the rainy season. Therefore, the feasibility for Bisa fanners of keeping animals is decreased. The significant difference in animal husbandry and entrustment between the villages reflects a development where agricultural expansion through conflicts has led to the resettlement of the Fulani, which has made it less feasible for Bisa farmers to keep animals. As animal husbandry is intrinsic to the mixed farming model, the expansion paradox becomes apparent, as agricultural expansion has led to worsened conditions for agricultural intensification.

VIII. Conclusion

In the following, the findings of the study will be summarised and related to the theoretical discussions in the first part of the dissertation. Together, the two components will, by answering the research questions, contribute to an understanding of development in Boulgou province and also to a better understanding of the applicability of the theoretical models applied. Finally, the findings will be related to the more general developmental perspectives of Burkina Faso.

I will start out by summarising what is now known of developments in the region and the two case villages.

The study region is dominated by the ethnic group Bisa, who are sedentary farmers. Population density is around 55 persons/km^2 and the annual population growth is significant, at around 2,7%. The agricultural system is based on subsistence production with a relatively high diversity, reflecting a risk-minimising strategy. Self-sufficiency in grain is not secured, and the agricultural system is based on the extensive cultivation of permanent or short-fallow fields. Animal traction and inorganic fertilisers are used by a significant number of farmers, but not to a degree that would characterise the systems as being intensive, though there are differences between the two villages as Lergo has a slightly higher prevalence of practices normally associated with intensification. Rather, developments in agriculture are dominated by the expansion of fields, especially towards the south where onchocerciasis (river blindness) infested areas along the shores of Lake Bagré created in 1992 by the Bagré hydroelectric dam. These areas were opened for cultivation after the eradication of onchocerciasis in the 1970's. Off-farm income, either from seasonal jobs or remittances from migrant children, is common among the farmers. The importance of off-farm income has not been studied in detail, and together with the lack of detailed studies of the labour economy this represents a major limitation in the present study. Animal husbandry is increasingly being taken up by the farmers, primarily for use as draft power and as an active investment. The economic feasibility of animal husbandry was markedly favoured by the 1994 devaluation of the CFA franc.

The region has experienced a rapid growth in animal husbandry and Boulgou province had, in 1995, the third-highest number of cattle in Burkina Faso, only surpassed by Seno and Gourma provinces. This was partly the result of an influx of pastoralists from the northern regions of the country and the adoption of animal husbandry among the farmers. The majority of animal husbandry is carried out by the pastoralists in the region. The composition of the pastoralist herds shows that they are primarily held for milk and breeding. The pastoralists in the study area, the Fulani, are sedentary and have been living with the Bisa societies for a long time. Consequently, they have built up a close relationship with the farming communities. One of the most important aspects of this is the entrustment system, where the Fulani take care of the

farmers' animals thus freeing up labour for the farming that would otherwise have to be allocated to the animal herding. The Fulani, however, are negatively affected by agricultural expansion, being forced to move away more or less permanently with their animals as herding becomes too difficult because of the many fields.
The animal husbandry of the Fulani is dependent on a high diversity of fodder resources, and hence require access to harvested fields, fallow fields, forests, and depressions. Access to these resources is made difficult by agricultural expansion which, through conflicts over crops damaged by stray animals, leads to the marginalisation of the Fulani, who are in a relatively disadvantaged position in the present tenure situation in Burkina Faso. This also affects the conditions for entering entrustment arrangements, which have become less attractive for both farmer and pastoralist.

A comparison between the two neighbouring case villages, Sanogo and Lergo, helps reveal the pattern of development going on in the region. The two villages situated only 4 km apart are different with respect to agricultural expansion and the related consequences for animal husbandry among the Fulani and the Bisa farmers, and because of their close location and general similarity they are under the influence of the same forces of change and may, therefore, reveal a trend in a development process. What happened in Sanogo before is what is happening in Lergo today.

With respect to agriculture, the two villages show different degrees of agricultural expansion, Sanogo, the northernmost village, has a higher cultivation density and has no more land available for further expansion. The agricultural expansion that is still taking place is, thus, located towards the south in the Lergo territory, where uncultivated land is still available, albeit at increasing distance from the villages. Animal husbandry is less prevalent in Sanogo than in Lergo and grain self-sufficiency is also lower in Sanogo, which could be related to less manure being available as there are fewer animals. In spite of the Sanogo farmers being slightly wealthier than their Lergo neighbours, animal traction is less widespread in Sanogo, which could be explained by the lesser use of entrustment among the Sanogo farmers.
Entrustment in Sanogo is made less feasible by the absence of the Fulani. In Sanogo, almost all the Fulani have moved their herds away to the Zangoula area 20 km south of the villages where the young household members have established permanent settlements. This shift in settlement is a direct result of the high cultivation density, and the pressure on the land is reflected in a marked difference in grazing patterns and herding strategies. The better access to pastures in the vicinity results in a less mobile grazing pattern in Lergo compared to Sanogo, where in the latter the animals are normally only present during part of the dry season. The presence of the Fulani and their herds is conducive to entrustment, which is much more prevalent in Lergo. However, conflicts are common in Lergo and entrustment is not very popular among the Fulani, hence there are indications that the Lergo Fulani will face increasing difficulties in the near future which are likely to result in a situation similar to the one found

culties in the near future which are likely to result in a situation similar to the one found in Sanogo today.

Thus, the scene is set for relating the development in the study area to more general models of agricultural development, as this may help to explain what is going on and point to what may be expected in the future.

The Boserupian model of agricultural intensification offers a description of agricultural development as a function of population density. Development is seen as going through various stages of increasingly shorter fallow periods ending up in a highly intensified agricultural system with several crops per year and high investment levels in the form of labour, inorganic fertiliser, labour-saving technologies, etc. The focus is on the length of the fallow period as an indication of intensification level, and agricultural expansion is seen as an integrated part of this process as no distinction is made between unused land and fallow land. Expansion therefore becomes a key forerunner of the intensification process. The model has received renewed attention, with empirical studies supporting the main thesis that high population densities are conducive to agricultural intensification through enhanced labour availability. However, the model and these studies rest on a set of preconditions that are not present in the study area, the most important of which include the lack of a high agricultural potential and secure tenure arrangements. Besides, the population densities are well below the levels found in the cases of successful intensification. Thus, by examining the preconditions for the model it may be partly possible to explain why intensification is not the dominating trend in the study area.
It may then be argued that the Boserup model is not relevant for the study area, but the influence of the model both within research and policy formulation is tremendous and can, as such, not be ignored. Development interventions in the study area are presently pursuing the ideas of agricultural intensification in trying to improve the situation of local communities. Thus, an improved understanding of the applicability of the model is highly relevant. Revealing a different aspect of the intensification model may, furthermore, shed light on the possibilities for agricultural intensification in the region.

Mixed farming is central to the model of agricultural intensification, as interaction between animal husbandry and fanning is being transformed into integration with the increasing need for animal traction (labour-saving technologies) and manure (higher input levels). It has been argued how these two driving forces behind mixed farming are highly ambiguous, but they nevertheless remain important incentives for the farmers in the study area to include animal husbandry in the agricultural system.

In the study area, an older study showed how the entrustment system is an important precondition for the farmers' adoption of animal husbandry, especially cattle. The study by Delgado in the region in the 1970's showed how the feasibility of acquiring cattle for animal traction or

for investment was closely related to the entrustment system, as it kept the opportunity costs in relation to labour at a minimum. The absence of entrustment would, because of the loss in terms of foregone harvests, render cattle rearing and animal traction prohibitive for the fanner. This result, of course, rests on a set of assumptions that must be fulfilled for the conclusion to be valid. It has been shown how these assumptions are still valid today for the study area, with a few modifications. Furthermore, the data from the two case villages support a relationship between the prevalence of cattle among the farmers and their engagement in the entrustment system. Farmers also confirmed this by expressing the desire to entrust had they more than two animals, as then herding would become too arduous for small children to manage. Thus, the conclusion from the Delgado study seems to be confirmed by the present study, though the higher profitability of having cattle based on the remarkable price increases following the devaluation may upset the variables in the original equation and improve the feasibility of keeping cattle for the farmer. However, the improved profitability of cattle rearing does not make entrustment less attractive in itself, and it may also be argued that animal traction will become less feasible as the required initial capital investment has increased. Thus, entrustment may still be seen as an important factor in the agricultural development towards intensification by rendering animal traction feasible for the farmer.

However, the entrustment system in the study area is suffering under agricultural expansion. This takes place through the following mechanisms:

1) Agricultural expansion leaves less land for grazing, especially during the rainy season, with the result that the Fulani move away permanently with the herds. Distant herds are difficult to control, and as the animals are very valuable (three bulls may well equal a year's harvest), control is desired by the farmer.
2) Trust between fanners and pastoralists, which is an indispensable precondition for the entrustment system, is being undermined by open animosity between the two groups. This is primarily caused by conflicts over damaged crops due to stray animals, which is directly related to agricultural expansion, which makes herding more difficult for the pastoralist. One direct cause for this is the narrowing and cutting of cattle corridors by farmers establishing new fields. These corridors are not only important as passageways but also as a grazing resource.
3) The relationship between farmers and pastoralists is being undermined by increased competition over access to the various resources initiated by agricultural expansion. This includes the depressions that have been shown to be important for the herder, both in the wet and the dry season, and access to the crop residue which is increasingly collected by the fanners for their own animals. This not only further worsens the relationship between the two groups, but also directly forces the pastoralist to find alternative pastures, with the consequent permanent migration of the latter as has been observed in Sanogo.

Therefore, expansion has clear negative consequences for the entrustment system. Therefore, the feasibility of animal husbandry both for the farmer and the pastoralist is being undermined, and therefore also the feasibility of further agricultural intensification through the integration of animal husbandry in the farming system. This is what I term the expansion paradox, where expansion instead of being an integrated forerunner of intensification, actually works against it.

This points to the importance of operating with a distinction between expansion and intensification, as expansion cannot simply be seen as a preliminary stage of agricultural intensification. Expansion should be seen as a process in itself that does not necessarily lead to an intensified agricultural system. As has been illustrated with the two case villages, this is especially important when two or more distinct cultural and socio-economic groups are dependent on the same resources. In this case, expansion in one system may lead to marginalisation in the other. An important precondition for the further intensification of the Bisa farming system is interaction with Fulani pastoralism, which shows how the expansion paradox may help explain the conditions for further agricultural intensification in the study area.

This said, it cannot be concluded that intensification in the study area will not occur. As discussed, agricultural intensification is not just a function of population density, but may also be explained in terms of e.g. market and policy incentives. However, it is questionable whether the economic potential of the region would favour such a development. Agricultural intensification would most likely improve the livelihood of the local population through increased income and possibly higher levels of food security. However, if expansion continues, which seems likely given the meagre potential for intensification and the current trends, the important economic potential represented by animal husbandry, notably cattle rearing, will be foregone. It has been shown how the profitability of having cattle has risen considerably since the devaluation, and that this effect is likely to be a long-term phenomenon due to increased demand for meat based on the accelerating urbanisation in West Africa. The comparative advantages of Burkina Faso, and specifically Boulgou Province, in relation to animal husbandry thus represent an important present and future economic potential. The Fulani and the entrustment system is a key to the feasibility of animal husbandry, which is why a marginalisation of the Fulani may have far-reaching negative consequences.

It has been argued that the lack of favourable preconditions for agricultural intensification may help explain the apparent lack of intensification. It is not possible here to determine which is the most critical factor; the preconditions or the expansion paradox, and there is probably no single answer. The differences between the two Bisa villages with respect to agricultural practices seem to be closely connected to the differences also observed in animal husbandry and entrustment, and this is supported by statements by the local population. I therefore find the expansion paradox to be a relevant mechanism in the conditions found in the

present study, though I cannot conclude that it is the only or even the major explanation. However, claiming that there is only one explanation for something as complex as natural resource management in a heterogeneous rural society such as in Africa would instantly make me very sceptical. It is much more likely that the issues analysed here in relation to both the preconditions and the expansion paradox are at play simultaneously, and that they take the lead so to speak interchangeably from case to case, or rather from farmer to farmer. My main ambition has been to show the effects of agricultural expansion on pastoralism in the region, as I see pastoralism as one of the major feasible economic activities of Burkina Faso. As the animal husbandry of the pastoralists is so closely related to the farming systems of the peasants, it has also been shown that this is not just a matter of the marginalisation of a minority group and their animal husbandry, but that it also has more far-reaching implications for further agricultural development.

The relationship between land use and the environment has been and is under the influence of several narratives. Especially in the Sahel, some narratives like desertification have had an important impact on policy formulation and development initiatives, which has led to futile aid investments and in some cases has directly damaged the pastoralist groups. New insight has shown how some of these narratives have evolved through the simplification and political misuse of research findings although research based on dubious data and methodological flaws also bears some of the blame. One of the most important outcomes of the debate on narratives is the acknowledgement that a complicated and heterogeneous reality can only seldom be boiled down to a simple causality which invites simple solutions. However, the need for simplification is still present in media and policy work and may thus result in the new findings also evolving into simplifications. New counter-narratives will then develop which may be based on better insights but are still narratives that simplify a complex reality. Such a counter-narrative evolving from the fallacies of older narratives could be, for instance, a perception that the problems in Africa are not so severe as once thought and that development interventions risk disturbing the free market mechanisms that will eventually solve the problem of development. Thus, a new simplification may take over as a result of the confrontation of the former doomsday scenarios, though with reductions in development aid as a consequence. The outcome of the narrative debate should be that alleviating poverty and promoting development is much more complicated than has hitherto been portrayed, and that development interventions need to be adjusted accordingly, but that this should not lead to a neglect of serious poverty and environmental problems that are still present in Africa.

The present study may contribute to an understanding of the complicated relationships in natural resource management in a West African perspective, and of how influential theories may be usefully applied in an environment where severe development problems still need attention.

IX. Limitations, scope, and policy considerations

The limitations of the study can be divided into limitations originating from the omission of certain issues, and limitations resulting from the methodologies chosen.

Concerning the omission of major issues, at least three can be identified that are central to agricultural development in the region. These are: the importance of off-farm income, the labour economy, and the tenure situation.

It is well known from several studies in Burkina Faso that off-farm income is an important factor in the livelihood strategies of the farmers. It has been shown that off-farm income is prevalent in the study area, but it has not been dealt with in detail, and may as such lead to an overestimation of the importance and potential of intensification in the region, as off-farm income may be a more feasible option for the farmer than to invest in agricultural productivity enhancements. However, off-farm income does not change the consequences of expansion for Fulani animal husbandry, which is the main object of study here. Besides, animal husbandry is increasingly being taken up by the farmers, either for direct use in crop cultivation as animal traction or as an active investment or saving. Though saving and investment may be more important for the farmer than animal traction because of disinterest in investing in agriculture, the role of the Fulani as facilitators of animal husbandry for farmers through the entrustment system is still important because of the related opportunity costs of labour and other advantages. Further studies into the importance of off-farm income possibilities would be important for a further assessment of the intensification potential of the region, and especially in relation to development interventions aimed at improving agricultural production in the region.

The lack of detailed studies into the labour economy especially of the farmers is another important limitation. The exact dynamics of labour allocation and the limitations thereby imposed on the agricultural production is not known today. However, the Delgado study looked into this in detail and my conclusions on the feasibility of on-farm cattle rearing were to a large degree, based on these findings. There are indications that labour is still a major bottleneck in agricultural production during peak periods of peak labour demand, especially weeding and the harvest. This is, of course, closely related to the possibilities of off-farm employment, and further studies dealing with the dynamics of labour allocation and the constraints hereof would be valuable for an assessment of the potentials for agricultural intensification.

The tenure situation in the region, as in Burkina Faso as a whole, is highly complex. It has only been covered superficially in the present study primarily because of practical limitations. However, research conducted in connection with the SEREIN program in the region (Lund, 1996) has more or less documented the present tenure situation. What is needed, and what the

present study unfortunately cannot provide, is a detailed study of actual tenure and hence power relations in the local context. Therefore, it is also not possible to provide more detailed recommendations for an improved tenure situation, although most of the policy considerations below actually involve alterations of the tenure relations and legislation to varying degree. However, the limited knowledge of the tenure relations does not influence the main findings of the study concerning the forced exclusion of the pastoralists and the conditions for entrustment due to agricultural expansion. A tenure study would add to an understanding of the marginal position of the Fulani, which results in them not being able to assert their right to grazing areas and cattle corridors, and as such would be helpful in finding ways to mitigate the consequences of agricultural expansion.

Concerning the limitations imposed by the choice and application of methods, a general reference can be made to the methodology section where several of these issues are discussed. The choice of methods not only affects the reliability of the study, but also the validity of the findings. As the validity is closely related to the scope of the study, this will be briefly elaborated upon in the following.

The methodology was designed to provide representativity of the target group and to reveal the dynamics behind the strategies employed by the pastoralists through the selection of respondents for further in-depth studies according to maximum variance over a specific set of variables. The investigations in the Bisa farming community were designed to be representative of the two villages. Concerning the pastoralist Fulani, the basic data cover all individuals and are hence representative, while the detailed cases serve to reveal the choices made by selected households in specific situations and through these more or less extreme cases to reveal the rationale behind the choices made by the pastoralists under different circumstances.

The scope of the study and the representativity of the findings is also heavily dependent on the choice of location and the choice of case villages. The choice of villages reflected a desire to demonstrate some of the processes of change going on in the region. Hence, the case villages should not only show current developments in the specific villages today, but also point towards an understanding of more general processes of change. Thus, the finding are seen as reasonably representative and valid for a large part of the province where saturation of land is taking place and pastoralist-based animal husbandry interacts with the farming communities, albeit with the limitations mentioned above.

The region is, furthermore, regarded as being reasonably representative of the West Africa Savannah region although with the limitations discussed in the methodology section. The point of departure for the present study has been empirical data collected during the fieldwork, and hence the actual processes of change that have been identified in the field. The choice of theoretical model is an attempt to generalise the findings further and in so doing also to add to a better understanding of the limitations and applicability of these theoretical models in a West African Savannah environment.

A. Policy considerations

Gaining an improved understanding of what is going on and why is one thing. Quite another is to translate it into practical measures. The conclusion of the study primarily constituted the understanding aspect, but as the field of development research, as I understand it, is also applied science, it is my ambition and hope that all the time invested by me and a lot of Burkinabé, who kindly lent me their time and not least patience, will not only serve to provide me with an academic degree, but also assist in the development efforts invested in Burkina Faso by, among others Danish donor organisations. The following concluding section has been intended for this purpose.

The policy considerations in the following are,largely, inspired by Delgado's recommendations from his studies in the region in the 1970's (Delgado, 1979a:301-332), as I believe that many of his observations are still relevant today.

Development in the Sahelian countries cannot be seen in isolation from the rest of West Africa. Because of the strong climatic North-South gradient there are important natural comparative advantages that should not be ignored but rather promoted for the benefit of all parties. As has been demonstrated, the economic feasibility of animal husbandry, and especially cattle rearing, is considerable and superior to crop cultivation in the study area. Thus, the following takes the point of departure in improving conditions for cattle rearing both for the farmer and the pastoralist. As will become evident, this leads to the apparent paradox that in order to support animal husbandry it is primarily the farming systems that should be looked into and possibly supported.

As has been shown, the entrustment system is crucial for the feasibility of the farmers' cattle rearing. Consequently, steps to improve the conditions for cattle should be sought as part of strategies aimed at supporting this system. One of the major problems with the entrustment system today is the deteriorating relationship between farmers and pastoralists, which is mainly due to conflicts triggered by crop damage caused by stray animals. Hence, this source of conflict should be addressed. Crop damage is, as shown, strongly related to agricultural expansion which is why control over the expansion of fields should be given a high priority. However, expansion is necessary for the farmers' subsistence, and population growth also foments this process. Therefore, an improved productivity on the village fields is probably the only way that the expansion can be controlled in an acceptable manner. Hence, some form of intensification on the village fields would actually benefit animal husbandry. As discussed, the region holds little potential for an autonomous intensification, but this does not mean that the productivity of the village fields cannot be improved, and thereby curbing the need for expansion.

Although animal husbandry may play an important role in supplying manure to the fields, intensification based on organic farming does not seem feasible. It has been shown that such systems may only yield sustained growth rates of around 1%, which is not sufficient to support a population growth of almost 3% (Reardon, 1994:3). Therefore, inputs like inorganic fertilisers, hybrid seeds, small-scale irrigation, and animal traction must also be considered if a relatively rapid increased productivity of the fields is to be obtained.

Several factors are important in this respect, of which one of the most important is an improved supply of nutrients, either as transfer of manure from cattle, or in the form of mulching, composting and inorganic fertilisers. By transfering manure from Fulani households to farmer households, the paradox could be avoided whereby the Fulani invest little labour in well-fertilised fields because their primary concern is cattle, while the farmers spend much labour on relatively infertile fields. If the Fulani's specialisation in animal husbandry were supported through the entrustment system, they would not be forced to invest so much effort in cultivation, though a certain subsistence production would probably still be required.

Also, improved varieties with shorter maturing periods may help to spread agricultural activities over a longer period of time, which would ease the labour bottlenecks that limit production.

Risk aversion may lead the farmer to plant an area larger than would be needed in a normal year in order to be sure to obtain a sufficient harvest in bad years. By improving his food security, the farmer might be encouraged to cultivate a smaller area, which would make expansion less problematic. Such improved food security could be established through improved grain storage facilities and the organisation of cereal banks. Also, research into and extension support for the diversifications of the farming system, with many crops of minor importance, might add to the farmers's food security (Mertz and Reenberg, 1999).

There are important links between poverty, the ability to invest in agricultural intensification, off-farm activities, and the environment. While most of the population in the study area can be characterised as being relatively poor with little or no surplus to invest in their land, not all farmers are equally poor. Moreover, as noted by Reardon and Vosti (1994:6), poverty may not only imply being welfare-poor but may also imply investment-poverty which signifies that even though there may be a certain surplus it may not be possible to convert this into e.g. enhancing the productivity of the land. This can be due to the lack of a market that can transform the surplus into investments, or to constraints in labour and other inputs. Thus, poverty may limit the possibilities for investing in agricultural intensification in several ways. As mentioned, off-farm activities make up a substantial part of many rural households' income. In marginal areas, there may be a competition between investments in land improvement and investment in other activities not related to agriculture. If agricultural potential is inadequate, off-farm activities may turn out to be more profitable, and investment in agricultural intensification would then be associated with opportunity costs for the fanner. Thus, even though the fanners are not constrained by welfare- or investment-poverty, agricultural intensification may

still not be a feasible option. This may have consequences for the environment, as sustained production requires a certain amount of recycling or import of nutrients and conservation of the land to mitigate the effects of erosion. All such activities are associated with investments either in the form of labour or materials. Besides, without investments in increased productivity and conservation on existing fields, the increased need for food following population growth is likely to result in agricultural expansion that results in deforestation and bare fields, which may increase erosion.

This said, there are also other rationales than the purely economic that may determine the willingness and ability to invest in land. People may have a strong cultural affiliation to the land or to their lifestyle as farmers, just as has been discussed in relation to the pastoralists. This may not be possible to validate economically, but also determines opportunity costs as the farmer evaluates them. Furthermore, the complex and uncertain tenure situation in Burkina Faso may give the farmer an incentive to develop the land he already uses in order to claim a right to that land.
Therefore, the possibilities for investment in agricultural intensification are dependent on several often very locality-specific conditions that may also have direct implications for the environment. The present study has shown how one more factor, the animal husbandry of the pastoralists and especially the entrustment system, may influence the potential for agricultural intensification in the region.

All of the above-mentioned factors must be taken into consideration when policy is designed. As has been discussed here, probably the most feasible way of preserving the pastoralists' animal husbandry in the study region is by supporting investment in agricultural intensification on the fanners' existing fields. However, such investments must be profitable for the farmer. Therefore, steps that could be taken include the following:

- Provision of inputs, especially inorganic fertilisers, at feasible prices
- A market for the products could be secured through price support and refinement of end products
- Provision of secure tenure linked to investments in land
- Provision of materials and infrastructure needed to adopt land conservation measures at feasible prices
- Provision of improved and locally-adapted crop varieties
- Investigation and support through research and extension work of labour- and cost efficient techniques to recycle nutrients and conserve resources
- Provision of cheap credits for investments

However, one thing is to increase the productivity of village fields, another is to protect grazing areas and assure access to crop residue and depressions. Such protection would require a

delimitation of the areas protected from expansion, much like a pastoral zone. As the region cannot be regarded as a non-equilibrium environment, the need for mobility, though present, does not include the long-distance transhumance found in the Sahelian regions. Therefore, pastoral zones may be an important and feasible support for animal husbandry, and this is also one of the issues that the pastoralists themselves are trying to promote. However, with the ambiguous tenure situation in Burkina Faso, this is a major challenge. One pastoral zone has already been established in the Nouhao valley with FAO support. This scheme was carefully planned, with designated areas for various activities, and a dairy facility was also established. However, the high degree of planning and intervention made the project dependent on external funding, which unfortunately has been partly withdrawn. The result is that it today is difficult to maintain the zoning boundaries, and encroachment of fields into the designated pastoral grazing areas is now prevalent.[80] Such activities probably stand a better chance of survival if based on local groups' own initiatives which are accepted by all involved parties as far as possible and founded on a perception of mutual benefits e.g. through the entrustment system. Such locally-based and officially-supported initiatives are underway in the region among pastoral groups, although their outcome is not yet known.

The protection of cattle corridors is another important issue. Today, most corridors are based on customary arrangements or agreements, which clearly are not efficient enough to keep them open. A clear legislation and registration of cattle corridors would be beneficial for the avoidance of conflicts. Such arrangements already exist for the major north-south corridors of which one runs right through the town of Tenkodogo. The tracts could be marked by posts and a legislation agreed that the herder would not be liable for damage incurred to crops within e.g. 50 meters on both sides of the posts.
It would also be beneficial for the entrustment system if the risk of crop damage was shared between owner and herder, as today it is the sole burden of the herder. In this way, the farmers would also have an incentive to protect the cattle corridors and limit agricultural expansion.

Thus, possibilities exist for improving the feasibility of animal husbandry in the region and thereby contributing to the further development of Burkina Faso through an activity for which she has a natural and important comparative advantage, also on a long-term basis. However, agricultural expansion is rapidly transforming pastures into fields and marginalizing the pastoralists. One likely consequence of this process is the eventual permanent migration of the pastoralists and their animals to more favourable environments, which will probably be found towards the south, that is, outside the borders of Burkina Faso. Pastoralist-based animal husbandry may therefore not only represent a squandered opportunity, but may be lost altogether.

[80] Personal communication with Charles Ouedraogo, Director of Projet Nouhao and own observation.

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XI. Index

XII. Appendices

Appendix 1

Table 16 Pair-wise matrix ranking of preferred trees for cattle browsing for two respondents and availability for one respondent

Ranking	***Tree Specie***		
	Preference Fulani 1	***Preference Fulani 2***	***Availability***
1	*Kahi*	*Khaiki*	*Alu'ude*
2	*Tanni*	*Alu'ude*	*Kahi*
3	*Banuhi*	*Gilohi*	*Banuhi*
4	*Khorle/ Poli-pilo/ Gilohi*	*Banuhi*	*Khorle*
5	*Alu'ude*	*Kahi*	*Pilo-pilo**
6	*Khaiki*	*Tanni*	*Tanni*
7	*I'bi*	*Khorle*	
8	*Boodi*	*I'bi*	
9		*Pilo-Pilo*	
10		*Boodi*	

* Pilo-pilo is a bush

Table 17 Pair-wise matrix scoring of preferred fodder in the dry season for three respondents (trees excluded)

Ranking	***Grass Specie and Crop Residue***		
	Fulani 1	***Fulani 2***	***Fulani 3***
1	*Parguri*	*Leaves White Sorghum*	*Leaves White Sorghum*
2	*Kelemtegre*	*Parguri / Stems White Sorghum*	*Stems White Sorghum*
3	*Séeno*	*Séeno /Leaves Millet*	*Bulguré*
4	*Rhemsa*	*Bulguré*	*Séeno*
5	*Leaves White Sorghum*	*Yiamtaré*	*Niello*
6	*Niello*	*Niello*	*Leaves Millet*
7	*Yiamtare*	*Kelemtegre*	*Yiantaré*
8	*Zemtaba*	*Kjelbi Danegi*	*Parguri*
9	*Stems White Sorghum*	*Rhemsa*	*Rhemsa*
10	*Kjelbi Danegi*	*Bogodollo*	*Kelemtegre*
11	*Kiide*	*Kjelbi Allegi*	*Bogodollo*
12	*Leaves Groundnut*	*Kjelbi Bodegi /Leaves Red Sorghum*	*Kjelbi Allégi*
13	*Kjelbi Allegi*	*Zemtaba*	*Kjelbi Bodègi*
14	*Bogodollo*	*Buurgi*	*Kiide*
15	*Buurgi*	*Stems Millet*	*Kjelbi Danegi*
16	*Leaves Red Sorghum*	*Stems Red Sorghum*	*Buurgi*
17	*Leaves Millet*	*Leaves Groundnut*	*Leaves Groundnut*
18	*Stems Millet*	*Kiide*	
19	*Stems Red Sorghum*		

Appendix 2

Table 18 Fulbe, More and scientific names of grasses browsed by cattle

Fulbe name (More name)	***Scientific name***
Barere (Baaré)	
Bogodollo	*Pennisetum pedicellatum*
Bulgure (Kolomkoûdo)	*Oryza longisteminate*
Buurgi	
Gombasao (Goromsaougo)	*Londetia simplex*
Kagarire (Kagré)	*Andropogon gayanus*
Kelemtégre	*Com. tisp. incul.*
Kiidi	*Vetivenia nigitara*
Kjelbi Balegi, (French: cam-cram)	*Cenchrus biflorus*
Kjelbi Bodegi (Mopui)	*Schizechyrium brevifolium*
Kjelbi Danegi	
Laidi	
Moorso	
Niello (Kalgnaga)	*Rottbaillia cochinchinensis*
Ny 'ngého	*Shoenefeldia gracilis*
Parguri	
Red Sorghum	*Sorghum bicolor*
Rhemsa	*Alysicorpus ovalifobius*
Seeno	*Andropogon gayanus*
Sorghum, white Medium Grain	*Sorghum bicolor*
Uôdo Rhanéro	
Wullurde	*Cymbogon schoenanthus*
Yiamtàrde (Makam)	*Gen. sp. indet.*
Youm Lané (Nunuungu)	*Hypsis spigigera*
Zemtaba	*Andropogon pludapricus*

Table 19 Fulbe and scientific names for tree species browsed by cattle

Fulbe name	Scientific name
Abishe	
Alluki	
Alu'ude	Acacia sieberiana
Banuhi	Pterocarpus erinaceas
Boodi	Terminalia avicennioides
Gilohi	Stereospernum kunihianum
I'bi	Ficus gnaphalocarpa
Kha'hi	Khaya senegalensis
Khaiki	
Khorle	Mitragyna inermis
Kjéki	Faidherbia albida
Patouni	Acacia seyal
Pilo-pilo	Combretum paniculatum
Tanni	Balanites aegyptiaca

Table 20 English, French, More and scientific names ofcommon crops (after Mertz and Reenberg, 1999).

English	French	More	Scientific
Bambara groundnut	Pois de terre	Suma	Vigna subteranea L.
Cassava, Tapioca	Manioc	Banke	Manihot esculenta Crantz
Cotton	Coton	Lambo	Gossypium sp.
Cowpea	Haricots, niebé	Benga	Vigna unguiculata (L.) Walp.
Groundnut	Arachide	Nanguri	Arachis hypogaea L.
Maize	Maïs	Kamaana	Zea Mays L.
Pearl millet	Petit mil	Kazui	Pennisetum americanum (L.) K. Schum.
Rice, Paddy	Riz	Mui	Oryza sativa L. or Oryza glaberima L.
Sorghum, red	Sorgho rouge	Ka-zeega	Sorghum bicolor (L.) Moench
Sorghum, white, large grain	Sorgho blanc	Wanga	Sorghum bicolor (L.) Moench
Sorghum, white, medium grain	Sorgho blanc	Baninga	Sorghum bicolor (L.) Moench
Sorghum, white, small grain	Sorgho blanc	Sommui	Sorghum bicolor (L.) Moench
Soy bean	Soja	Soza	Glycine max (L.) Merr.
Tomato	Tomate	Tomato	Solanum lycopersicon L.

Appendix 3

Questionnaire used with Bisa farmers in Sanogo and Lergo.

Enquête no: Date: Village et lieu:

Nom de chef de famille:

Age de chef de famille: Ethnie:

No. de personnes dans le court:

Femmes: Enfants: Frères:

Parents: Autres:

Quand installé dans le village:

Venant de:

Pourquoi sont-ils venus?:

Quelles champs avez-vous? -avec indication de la culture, placement, distance environ, première année d'utilisation par ordre de taille:

Ordre de taille	Cultures	Emplacement (nom village proche, direction etc.)	Distance	Utilisation commencée
1 (Le plus				
2				
3				
4				
5				
6				

Si'l y a des nouveaux champs, pour quelle raison est-ce qu'on les établissaient?

Trouvez-vous que se soit difficile de trouver des nouveaux champs?

Si vous allez établir un nouveau champ, où allez-vous remplacer?

Avez-vous des champs en jachères?

Si oui: Jachère commencé?

Quand comptez-vous de réutiliser le champ?

Si non: Pourquoi n'utilisez-vous pas de jachère?

Est ce que vous utilisez jamais de jachère?

Sur quelles champs et cultures avez-vous utilisé de fumier?

D'où vient le fumier?

Est ce qu'il y a des Peuhl qui se sont s'installés avec un parc dans votre champs?

Si oui: Sur quels champs et cultures?

Dans quel mois se sont ils installés?

Pour combien de temps sont ils restés dans votre champ?

Est ce que c'est toujours les mêmes Peuhl qui viennent?

Est ce que vous avez payé pour l'installation?

Est ce que vous les avez invités de s'installer?

Si non: Pourquoi ils ne se sont pas installés dans votre champ?

Est ce qu'ils s'installent jamais dans vos champs?

Si oui: Quand?

Pourquoi sont-ils cessés de venir?

Utilisez-vous traction animale?

Si oui: Avec quels outils?
(charrette, petite charrue, grande charrue)

Quels et combien d'animaux de traction avez vous?

L'âge des animaux?

Quand avez-vous commencé d'utiliser la traction animale?

Après que vous avez commencé d'utiliser la traction animale, avez vous étendu votre champs de cultures?

Sinon: Pourquoi vous n'utilisez pas la traction animale?

Utilisez-vous des machines de quelques sortes dans votre production agricole?

Combien avez-vous récolté en 1996?
en unité de sacs de combien de kilos ou panier de combien de tasses ou de charrette

Culture	Quantité.	Unité He mesure.
Petit mil		
Sorgho rouge		
Sorgho blanc		
Arachide		
Haricots		
Mais		

Est ce que votre récolte va durer jusqu'à la nouvelle récolte?

Est ce que vous avez acheté du grain en 1996?

Si oui: Combien et dans quel mois?

Est ce que c'est normale que vous achetez pour compléter votre besoin de céréales?

Est ce que vous avez vendu de culture en 1996?

Si oui: lesquels et combien?

Est-ce-qu'un membre du ménage a fait du travail payé au dehors l'agriculture pendant 1996?

Si oui: Quel travail, où et pour combien de temps?

Quels et combien d'animaux avez vous?

	No. maie	No. femelle	Age des animaux
Bovin			
Moutons			
Chèvres			
Anes			
Chevaux			

Est ce que vous avez maintenant plus ou moins d'animaux par rapport à avant?

Si'l y a un changement c'est à cause de quoi?

Si'l y a des bovins: Pourquoi avez-vous des bovins?

Quand avez-vous commence d'avoir des bovins?

Quels pâturages utilisez-vous pour les bovins?

Trouvez-vous que il est difficile de trouver de pâturage pour les bovins?

Qui garde les bovins?

Est ce que vous avez confié des bovins aux Peuhl?

Si oui: Combien des bovins avez-vous confié?
Maies: Femelles:

Pendant quelle période de l'année restent les bovins avec les Peuhl?

Est ce que vous payez les Peuhl pour garder votre animaux?

Si oui: combien?

Pourquoi avez vous confié des animaux aux Peuhl?

Est ce que vous confiez des bovins aux Peuhl chaque année?

Est es que c'est toujours le même Peuhl?

Nom et village de Peuhl?

Sinon: Pourquoi vous ne confiez pas des bovins aux Peuhl?

Est ce que vous avez confié des bovins aux Peuhl avant?

Si oui: Quand et pour combien de temps?

Pourquoi avez vous cessé de confier des bovins aux Peuhl?

Pensez-vous que vous allez le faire dans l'avenir?

Dansk resumé af Ph.D. afhandlingen "Cattle, conflict and change: Animal husbandry and Fulani-farmer interactions in Boulgou Province, Burkina Faso"

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Resumé af Ph.D. afhandlingen "Cattle, conflict and change: Animal husbandry and Fulani-farmer interactions in Boulgou Province, Burkina Faso"

Afhandlingen beskæftiger sig med udviklingen i nogle landbrugssystemer og arealanvendelsen i det Vestafrikanske savanne område, her repræsenteret ved Boulgou provinsen i det sydlige Burkina Faso. Karakteristisk for området er sameksistensen af to kulturelt og funktionsmæssigt adskilte befolkningsgrupper, Bisa'erne, der hovedsagelig er fastboende agerbrugere, og Fulani'erne, der fortrinsvis ernærer sig ved kvægopdræt. Disse to befolkningsgrupper har gennem adskillige årtier udviklet flere væsentlige forbindelser mellem deres respektive aktiviteter til fordel for begge parter. En af disse er "kvæg-forpagtning" (entrustment) hvor bønderne overlader deres kvæg til pastoralister som passer dem sammen med deres egne dyr, og således sparer bønderne for arbejdet med at passe dyrene. En sådan forpagtningsaftale kan være kort- og langsigtet, og er et vigtigt element i bøndernes muligheder for at intensivere deres landbrug gennem indførelsen aftrækdyr. Imidlertid presses pastoralisterne væk af udvidelser af landbrugsarealerne som medfører konflikter mellem de to grupper. Dette har negative konsekvenser for de komplementære forbindelser der er mellem bønder og pastoralister, hvilket igen forringer dels muligheden for at udnytte kvægopdræt som en vigtig økonomisk aktivitet med et stort potentiale for Burkina Faso pga. komparative fordele, og dels mulighederne for bønderne for at intensivere deres landbrug gennem indførelsen af trækdyr.

Intensivering af landbrug i Afrika ses ofte som en udviklingsmodel, der aktivt søges fremmet gennem diverse projekter eller programmer. Ofte indgår en form for kreditordning, som skal hjælpe bønderne med at overkomme de nødvendige investeringer i materiel og diverse inputs. Imidlertid er der en række forudsætninger som bør være opfyldt, for at intensivering vil være en attraktiv mulighed for bønderne. Nylige eksempler fra Østafrika har vist, hvorledes intensivering af landbruget kan lade sig gøre uden at det går udover miljøet, og afhandlingen sætter erfaringerne fra disse områder ind i en Vestafrikansk kontekst ved at sammenligne forudsætningerne for denne udvikling. I forbindelse hermed inddrages Ester Boserups teorier om landbrugsintensivering. Disse teorier har haft stor indflydelse på opfattelsen af landbrugsudvikling i Afrika, og mange udviklingsinitiativer bygger implicit på elementer af disse teorier. Derfor er det vigtigt at forstå

disse teoriers gyldighed i det aktuelle miljø, idet der hermed også kan opnås en forståelse for lokalbefolkningens handlemåde, som er en forudsætning for at kunne yde den rette bistand.

En af de væsentligste elementer i Boserups teorier er den gradvise overgang fra ekstensivt landbrug og ekspansion af landbrugsarealerne, til intensivt landbrug når der ikke længere er mere uudnyttet land at inddrage. Ekspansion ses i Boserups teorier som en integreret del af intensivering, som en form for forløber i processen, og bliver ikke behandlet som en selvstændig udviklingsproces. I afhandlingen sættes der fokus på denne overgang, idet der argumenteres for at ekspansion og intensivering har så forskellige karakteristika, at man risikerer at overse væsentlige udviklingsmæssige begrænsninger, hvis de ses som en del af den samme proces. Dette illustreres i afhandlingen med en detaljeret analyse af to landsbysamfund i Boulgou provinsen, hvor forskelligt pres på ressourcerne ikke har medført en tilsvarende udvikling hen mod intensivering, som ville være at forvente ifølge Boserups teorier. Afhandlingen argumenterer for at dette forhold til dels bunder i, at ekspansionen af landbrugsområderne har negative konsekvenser for mulighederne for at intensivere landbruget, og begrebet "ekspansions paradoks" indføres. Paradokset består i, at man ifølge Boserups teorier ville forvente at ekspansionen ville ophøre når der ikke er mere uudnyttet land til rådighed, hvorefter bønderne bliver nødt til at intensivere deres produktion såfremt udbytteniveauet skal fastholdes eller forøges. Eksemplerne i Boulgou viser, at grunden til at dette ikke sker til dels kan forklares ved at husdyrhold og agerbrug for størstedelens vedkommende er baseret i adskilte systemer, der praktiseres af socio-økonomisk og kulturelt distinkte befolkningsgrupper. Således fører udvidelsen af en aktivitet, landbruget, til begrænsninger for den anden aktivitet, husdyrholdet, idet græsningsressourcerne indskrænkes, hvilket besværliggør pasning af dyrene. Et af de største problemer i forbindelse hermed er, at den større tæthed af marker gør det sværere for hyrderne at forhindre kvæget i at trænge ind på markerne og ødelægge afgrøderne. Dette fører jævnligt til konflikter mellem de to grupper, og medfører at forholdet mellem dem generelt forværres. Dette har igen negative konsekvenser for kvægforpagtningssystemet, idet gensidig tillid er en absolut forudsætning for at bønderne tør betro en så stor økonomisk værdi som kvæg udgør til en anden person. Tilliden mellem de to grupper er blevet forværret gennem gentagne konflikter og konkurrence om adgang til jord og græsning, således at forpagtningssystemet ikke længere er populært og sandsynligvis er ved at forsvinde. Herved bliver bødernes muligheder for at holde kvæg forringet, idet de selv skal afse arbejdskraft til pasning af dyrene, hvilket ofte vil være en afgørende faktor. Det bliver derfor sværere og dyrere for

bonden at indføre trækdyr eller okse-mekanisering i landbruget, og mulighederne for at intensivere landbrugsproduktionen bliver forringet. På denne måde forklarer ekspansions paradokset hvorledes ekspansion ikke kan ses som en integreret forløber for intensiveringen, men tværtimod må ses som en selvstændig proces, der under de her beskrevne forhold direkte kan modvirke en videre intensivering. En funktionsmæssig opdeling af husdyrhold og landbrug baseret på etniske grupper er ikke unikt for Boulgou provinsen, men genfindes mange steder i Afrika. Ligeledes er ekspansion af landbrugsområder en almindeligt forekommende proces som ofte fører til konflikter mellem bønder og pastoralister. For Burkina Faso, beliggende i Sahel bæltet, fører denne proces til at mulighederne for kvægopdræt forringes. Kvægopdræt er en af de få aktiviteter hvor Burkina har komparative fordele i forhold til de sydlige kystlande, idet sygdomme i disse områder forhindrer kvægopdræt af betydning. Ekspansion af landbrugsområder uden efterfølgende intensivering leder derfor til, at en aktivitet med stort økonomisk potentiale erstattes af landbrug med et ringe potentiale og med mulige negative miljøkonsekvenser.
Ekspansions paradokset kan derfor medvirke til bedre at forstå konsekvenserne af almindelige udviklingsprocesser som de forekommer i dag i mange områder af Afrika, og som har stor umiddelbar betydning for udviklingen af Burkina Faso.

De her beskrevne processer er særdeles komplicerede og mange forhold, både af lokal og mere generel karakter, spiller en rolle. I afhandlingen forsøges en skelnen mellem diverse forhold der kan forklare en manglende intensivering i de undersøgte områder. Det er forfatterens opfattelse at ekspansions paradokset er en relevant forklaringsmodel, men samtidig er det vigtigt at understrege at andre faktorer også må tages i betragtning. Her tænkes specielt på husholdets muligheder for at ernære sig ved andet end landbrug, som kan spille en væsentlig rolle som et alternativ til en bekostelig og muligvis risikabel intensivering af landbrugsproduktionen. Et vigtigt element heri er ligeledes den arbejdskraft der er til rådighed, specielt i perioder hvor der er ekstraordinært stort behov for arbejdskraft, eks. ved høst og lugning. Disse forhold har det ikke været muligt at undersøge til bunds in undersøgelsesområdet, om end denne udladelse i afhandlingen bliver vurderet i forhold til relevansen for validiteten af resultaterne. Der argumenteres således i afhandlingen for, at ekspansions paradokset kan medvirke til at gøre teorierne omkring intensivering mere relevante i en Vestafrikansk savanne kontekst, og dermed skabe et bedre grundlag, for at forstå de meget komplicerede processer som foregår nu, og som kan have store miljø- og samfundsmæssige konsekvenser.

Afhandlingen er opdelt i 9 kapitler, hvoraf de to første opridser problemstillingen samt giver en kort introduktion til området. Kapitel 3 omhandler den valgte metodiske tilgang. Der redegøres for, hvorledes afhandlingen er baseret på empirisk primært materiale af hovedsagelig, men ikke udelukkende, kvalitativ karakter, samt hvilke konsekvenser dette har for feltarbejds- samt analysemetoder. Desuden diskuteres hvorledes afhandlingen benytter en blanding af farming systems approach og livelihood studies som den valgte tilgang samt de begrænsninger der er forbundet hermed. Et yderligere metodisk problem er den korte varighed feltarbejdet strakte sig over (hovedsagelig _ år) hvormed man risikerer at opnå kun et øjebliksbillede af en kompliceret proces. Jeg har forsøgt at kompensere for denne tvungne begrænsning ved at inkorporere historiske sekundære data fra forskellige kilder, ved at inddrage historiske forhold i interviewene, ved at vælge to landsbyer som evt. kan vise en udviklingstendens, og ved at sammenligne flyfoto fra forskellige perioder. Endelig argumenteres der for valget af en induktivt orienteret forskningsmetode, samt hvorfor der er benyttet underspørgsmål til at lede forskningen frem for en egentlig hypotese testning.

Kapitel 4 redegør for samt diskuterer de valgte teorier af relevans for forskningens genstandfelt. Kapitlet er inddelt i 4 underkapitler. I det første argumenteres for den valgte definition af et af afhandlingens grundbegreber, intensifikation, samt hvorledes dette kan måles i praksis. Specielt behandles Boserups fokus på brakperioden som et afgørende mål for intensifikation, og der argumenteres for at brakperioden ikke er en entydigt praksis, hvorfor man herudover bør benytte en kombination af faktorer som arbejdskraft- og kapital investering per arealenhed, benyttet teknologi samt udbytte.
I underafsnit B sættes Boserups teorier om intensifikation ind i en historisk sammenhæng, bl.a. ved at forholde dem til Malthus samt neo-Mathus ideerne om sammenhængen mellem befolkningsvækst, levevilkår og miljø. Det diskuteres hvorledes Boserup har behandler nogle af de samme forhold som Malthus, men med vægt på at teknologisk udvikling og øget arbejdskraft- og kapital investeringer, vil kunne opveje nedgangen i jordens bæreevne som følge afkortere brakperioder, som følge af et større pres på jorden afstedkommet af befolkningsvækst. Et vigtigt begreb her er faldende marginaludbytte ved arbejdskraftinvestering, som sammen med et pres for højere udbytter ifølge Boserup, vil resultere i indførelsen af ny arbejdskraftbesparende teknologi som f.eks. okse trækkraft. Nyere forskning sår tvivl om denne mekanisme, men selvom tesen om

faldende marginaludbytte ikke holder, afviser det ikke at presset fra befolkningsvækst kan afstedkomme intensifikation, men snarere åbner det op for andre forklaringer end faldende marginaludbytte, på hvorfor intensivering også kan forefindes i områder med relativt lille befolkningstæthed. Endvidere redegøres for Boserups syn på ekspansion som en integreret del af intensifikationsprocessen. Ved at gennemgå centrale forhold som udbytte/arbejdstime, udbytte/arealenhed, input/arealenhed, arbejdsbyrde/person samt miljøkonsekvenser for henholdsvis intensifikation og ekspansion argumenteres for, at disse to begreber er så væsensforskellige at det er vildledende at sammenholde dem i en og samme proces. Dette argument tages med i en gennemgang af ekspansions paradokset som omtalt tidligere, og endelig diskuteres andre forhold end befolkningspres, som kan drive en intensifikationsproces. Specielt vigtigt er her gode markedsforhold, samt politisk styrede udviklingsinitiativer eller produktionsfremmende foranstaltninger. Som et eksempel på en vellykket intensifikationsproces gennemgås Machakos studiet i Kenya, som netop var en kombination af bestemte historiske forhold, gode markedsmuligheder og høj befolkningstæthed. Dette leder hen til en mere generel opsamling af hvilke forudsætninger man har erfaring for er nødvendige, for at en intensifikationsproces kan forløbe. Nogle af de vigtigste her er et vist økonomisk potentiale i naturressourcerne, god placering mht. infrastruktur og markedsadgang, sikkerhed og socio-økonomiske støttestrukturer som f.eks. afklarede jordrettigheder og officielle støtteordninger.

En intensifikationsproces i den aktuelle kontekst vil typisk gå gennem et såkaldt mixed farming model som er behandlet i underkapitel C. Her diskuteres, med udgangspunkt i litteraturen, hvilke forudsætninger denne model bygger på, samt hvorledes specielt oksemekanisering er en del heraf. Det konkluderes at mixed farming modellen ikke kan tages for givet, idet der er flere faktorer der er kritiske for hvor attraktiv denne model vil være for bonden. En væsentlig faktor er det ekstra arbejde der medgår ved pasningen af dyrene, samt den forholdsvis store investering dyrene samt udstyret repræsenterer for bonden. Efterfølgende diskuteres derfor mere detaljeret kvægforpagtningssystemet, og det vises, bl.a. med udgangspunkt i ældre studier fra samme region, hvorledes dette system er den økonomisk mest optimale måde for bonden at indføre trækdyr i sin produktion, og derved intensivere landbruget. Dette bunder hovedsagelig i høje skyggeomkostninger, som stammer for det arbejde der skal afses til pasning af dyrene hvis bonden beholder dem selv. Herved fremstår kvægforpagtning som en væsentlig faktor i forbindelse med

udviklingen af mixed farming systemet, og dermed også for intensiveringen af landbrugsproduktionen.

Underkapitel D gennemgår nogle af de narrativer som for nylig er blevet tildelt stor interesse indenfor miljøforskning i udviklingslande. Kritikken af narrativer lægger vægt på at forskningen bør være uafhængig af økonomiske og andre interesser, og specielt er der fokus på hvorledes en del forskning er baseret på en form for ukritisk accepteret sandhed, som det i flere tilfælde har vist sig ikke kunne tåle en nærmere gennemgang. I kapitlet diskuteres desertifikation, "tragedy of the commons", samt "the cattle complex" narrativerne idet de har speciel relevans for det aktuelle studie. Selvom den nyere forskning i narrativer og den efterfølgende debat, har givet anledning til væsentlig og vigtig nytænkning, og har afsløret en del faldgruber indenfor dette forskningsfelt, har debatten dog den bagside at det nemt kan reduceres til en ny form for narrativ, en såkaldt "counter-narrative" der modsiger at der findes reelle problemer i disse områder, og dermed undergraver motiverne for donorbistanden. Det er mit standpunkt, at fremkomsten af et sådant counter-narative er en realitet allerede, og at det ikke er en positiv udvikling. Narrativ debatten bør tværtimod bruges som inspiration til at udføre bedre uafhængig forskning fri for fordomme og forudfattede meninger og løsningsmodeller, og bør ikke reduceres til en kapløb om at punktere myter.

I kapitel 5 redegøres mere i detaljer for de feltarbejdsmetoder der blev benyttet. Feltarbejdet blev udført over 2 perioder; en af 1_ måneds varighed og en af 5 måneders varighed. De to landsbysamfund er udvalgt så de kan bruges som basis for sammenlignende forskning (comparative reserach), hvilket indebærer at der er forsøgt holdt så mange uafhængige variable konstante som muligt, så variationen i de udvalgte afhængige variabel kan undersøges. Desuden er studiet for en stor del baseret på cases og specielt er principperne for ekstreme cases benyttet i forbindelse med pastoralisterne. Undersøgelserne af henholdsvis bønder og pastoralister blev udført forskelligt, idet der ved de to landsbyer med agerbrugere, Sanogo og Lergo, blev benyttet spørgeskemaer, som blev udfyldt ved interviews gennemført af to lokale assistenter. På denne måde kunne ca. halvdelen af husholdene dækkes, i alt 97. De to pastoralist samfund er noget mindre, og blev dækket med semi-strukrurerede interviews gennemført af forfatteren med hjælp af en lokal tolk. Alle hushold blev interviewet, og adskillige blev interviewet gentagne gange over en 5 måneders periode. PRA (Participatory Rural Appraisal) metoder blev benyttet som supplement til interviewene. Det drejede sig specielt om rankings og her navnlig pairwise matrix ranking som i kapitlet diskuteres i detaljer.

Resultaterne af alle interview blev løbende indkodet i en relationsdatabase, som var særdeles nyttig til at give et øjeblikkeligt overblik over indsamlede data, samt ved den videre dataanalyse.

I kapitel 6 gennemgås de væsentligste forhold i Boulgou provinsen for at give den lokale kontekst for den videre analyse. Specielt lægges der vægt på kvægholdets nylige store vækst og store betydning for regionen, samt den meget høje værdi som kvæget repræsenterer, specielt set i forhold til et almindeligt høstudbytte. Husdyrhold praktiseres i regionen i basalt set tre forskellige former; husdyrhold hos fastboende pastoralister, husdyrhold hos agerbrugerne, samt det kvæg der tilhører transhumane pastoralister som passerer gennem regionen i tørtiden. Sidstnævnte er ikke dækket i dette studie af praktiske årsager, men deres indflydelse på lokal naturressourceforvaltning er beskeden. Desuden redegøres der i detaljer for hvorledes 50% devalueringen af CFA franc'en i 1993, har haft stor positiv effekt for kvæghold i Burkina Faso gennem øget efterspørgsel på kystmarkederne og dermed forhøjede priser. Dette har bl.a. betydet, at eksporten af kvæg fra regionen er steget voldsomt siden devalueringen, hvilket på samme tid gør husdyrhold mere attraktivt for bønderne, og gør det dyrere at anskaffe dyr som trækkraft. Endelig ses der på, om der i regionen fra et overordnet synspunkt kan genfindes elementer af en intensifikationsproces. Dette kan der kun i ringe grad, og sammenligning med studier fra naboregioner i Ghana og Togo peger ikke på at landbrugsintensifikation har et stort potentiale.

Kapitel 7 består af en detaljeret analyse af dels dataene fra interviewundersøgelsen med agerbrugene, og dels fra interviewene med pastoralisterne. Analysen af Bisa bønderne viser at der er markante forskelle mellem de to landsbyer. I Lergo er der generelt mere ubrugt land til rådighed sammenligned med Sanogo, og markerne er ligeledes yngre her. Husdyrhold er mere udbredt i Lergo, og bønderne har generelt en højere andel af selvforsyning end bønderne i Sanogo. Selvom Sanogo har nået grænsen for inddragelse af mere land til dyrkning, er der ingen tegn på at der foregår en intensiveringsproces. Tværtimod er pengeafgrøder, trækdyr, brug af gødning og selvforsyning, forhold som normalt er associeret med intensivering, mere udbredt i Lergo end i Sanogo, på trods af at presset på jorden i Lergo er mindre. I stedet er migration mere udbredt i Sanogo, som kunne tyde på at beboerne her måttet ty til alternativer til en landbrugsintensivering.

Disse resultater er fulgt op af analysen af pastoralisterne. Det vises her, hvorledes forskellene i arealanvendelse mellem de to Bisa landsbyer influerer på pastoralisternes græsningsmønster. I

Sanogo er pastoralisterne blevet tvunget til at flytte mere eller mindre permanent til områder ca. 30 km syd for landsbyen, idet mulighederne for konflikt fri græsning forværredes i takt med landbrugsudvidelserne. Dette er også afspejlet i græsningsmønsteret, som er betydeligt mere mobilt i Sanogo, idet pastoralisterne er tvunget til at søge længere væk for at finde egnet græsning. Disse ændringer er ledsaget af hyppige konflikter mellem de to grupper. Konflikterne kan have mange årsager, men de vigtigste er kvægets beskadigelse af afgrøder, bush brænde, konkurrence over land og græsningsressourcer, beskyldninger om kvægtyveri, samt almindelig misundelse over pastoralisternes i nogle tilfælde relativt høje velstand. Dette har ført til en forværring i forholdet mellem de to grupper, hvilket har negative konsekvenser for kvægforpagtningssystemet. Herved forringes bøndernes muligheder for at holde trækdyr, hvilket er afspejlet i en større udbredelse af kvægforpagtning i Lergo end i Sanogo, hvor der i sidstnævnte ligeledes er tendens til mindre integration af husdyrhold i landbruget. Dette peger på en sammenhæng mellem kvægforpagtning og mulighed for udvikling af landbruget, hvormed ekspansion paradokset er sandsynliggjort.
Således kan der i kapitel 8 konkluderes, at det er nødvendigt at operere med en distinktion mellem ekspansion og intensifikation, samt at ekspansions paradokset kan hjælpe til bedre at forstå, hvorfor intensifikation ikke nødvendigvis er en farbar vej for de lokale bønder. Det skal imidlertid bemærkes, at det i dette studie ikke er muligt direkte at afgøre, hvor stor en indflydelse de nævnte forudsætninger for intensifikation har på denne proces. Dette foregår i et kompliceret samspil, men med denne afhandling er der blevet gjort opmærksom på, at der i selve ekspansion- og intensifikationsprocessen ligeledes ligger nogle mekanismer, der udøver en begrænsning på muligheden for yderligere landbrugsudvikling.

Alle studier har grænser for gyldighed samt forbehold der nødvendigvis må tages. I kapitel 9 gennemgås nogle af de væsentligste begrænsninger i studiet. Dette er først og fremmest begrænsninger relateret til at betydningen af ikke-landbrugsrelaterede aktiviteter, arbejdskraftøkonomien, samt jordrettighederne, der ikke har kunne inddrages tilstrækkelig på grund af tidsmæssige og andre praktiske begrænsninger. Der redegøres for hvorledes disse kan have påvirket resultaterne, og yderligere studier i disse forhold vil givetvis medvirke til en fuldere forståelse.

Kapitlet afsluttes med en række praktiske anbefalinger som konsekvens af forskningsresultaterne. For at afhjælpe en situation, hvor en vigtige økonomisk aktivitet som kvægholdet med et stort

potentiale presses væk af landbrugsekspansion, må der skabes forhold der gør at det ikke er nødvendigt for bønderne at udvide deres arealer. Dette kan ske ved at støtte en form for lokalt adapteret intensivering af landbrugsproduktionen, således at et højere udbytte kan opnås på et mindre areal. En udvikling af landbruget vil dog næppe være tilstrækkeligt til at sikre kvægbrugets og forpagtningssystemets overlevelse. En form for beskyttelse af pastoralisternes græsningsrettigheder vil være nødvendig. En mulighed her er oprettelsen af pastorale zoner baseret på sammenslutninger af lokale pastoralister. Sådanne initiativer er under udvikling, men deres skæbne er endnu uvist. Beskyttelse af kvægkorridorer er en anden forudsætning for at undgå konflikter mellem de to grupper, og generelt bør pastoralisternes indflydelse på lokal naturressourceforvaltning styrkes, idet de i dag oftest kun har en marginal indflydelse på beslutningerne, da det er de fastboende bønder der traditionelt råder over adgangen til jorden.